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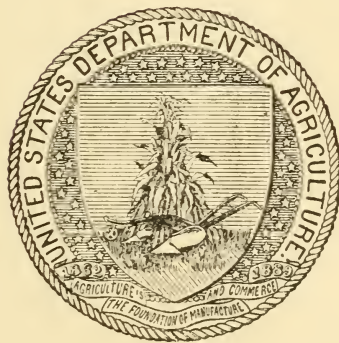
U. S. DEPARTMENT OF AGRICULTURE.

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Report No. 82.

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PROGRESS  
OF THE  
BEET-SUGAR INDUSTRY  
IN  
THE UNITED STATES  
IN  
1905.



WASHINGTON:  
GOVERNMENT PRINTING OFFICE.  
1906.





*To the Senate and House of Representatives:*

I transmit herewith for the information of the Congress a report on the Progress of the Beet-Sugar Industry in the United States in 1905. Your attention is respectfully invited to the accompanying letter of the Secretary of Agriculture, recommending that 10,000 copies of the report be printed for the use of the Department of Agriculture in addition to such number as may be desired for the use of the Senate and House of Representatives.

THEODORE ROOSEVELT.

THE WHITE HOUSE,  
*April 27, 1906.*

## LETTER OF TRANSMITTAL.

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U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SECRETARY,  
*Washington, D. C., April 24, 1906.*

MR. PRESIDENT: I have the honor to transmit herewith for your information and that of the Congress of the United States a report entitled "Progress of the Beet-Sugar Industry in the United States during 1905," prepared by Mr. Charles F. Saylor, special agent of this Department. The report also includes a brief account of the "Sugar-beet Investigations conducted by the Bureau of Plant Industry."

In view of the popular interest in the subject of this report, I respectfully recommend that at least 10,000 copies of the report be printed for the use of this Department in addition to the number which Congress may in its wisdom order for the use of the members thereof.

I have the honor to remain, Mr. President, very respectfully,  
JAMES WILSON, *Secretary.*

The PRESIDENT,  
*The White House.*

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# PROGRESS OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES IN 1905.

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REPORT OF THE SPECIAL AGENT,  
CHARLES F. SAYLOR.

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## LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,  
OFFICE OF THE SPECIAL AGENT,  
*Washington, D. C., April 3, 1905.*

SIR: I submit herewith for your inspection and approval the manuscript of my ninth annual report on the Progress of the Beet-Sugar Industry in the United States. It contains a general review of the progress that has been made during the past year (1905), a survey of the prospects for factory building, and a limited amount of miscellaneous information concerning various phases of the industry.

Respectfully,

CHAS. F. SAYLOR,  
*Special Agent.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*

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## INTRODUCTION.

In making this, my ninth, annual report on the Progress of the Beet-Sugar Industry in the United States, I wish first to call attention to a few of the more striking features of its present development. In general it may be said that the progress being made is highly satisfactory to all the interests concerned. The pioneer period of the industry—the period of experiment, of investigation, of doubt, of mistakes—appears to have ended, and the period of confidence, of reliable information, of careful advancement along safe lines is well begun.

### ARID-LAND RECLAMATION AND DEVELOPMENT OF THE WEST.

A paramount fact in the development of our great West to-day is the reclamation of arid lands through irrigation. This is becoming the all-absorbing question in most of the area west of the 100th meridian. The great popular interest in this subject has been inspired largely by the National scheme of reclamation by the use of funds derived from the sale of public lands. The cost of the undertaking is

gigantic, but no less so than the industrial and social development which will speedily follow. The importance of the changes which will take place can hardly be estimated. Regions which are now barren and untenanted will be settled, towns and cities will be built and equipped with all of the modern means of communication—railroads, trolley lines, telephone and telegraph lines, and rural free delivery of mails—schools and churches will be built, and the population of these new communities will enjoy all the benefits and conveniences of modern life. To accomplish all this in a decade seems like the work of magic. One can hardly keep track of this evolution of the West. It appears like doing in a few years what has hitherto been considered the work of a century. Among the industries which will play the most important part in working this modern miracle is the beet-sugar industry. Some of these Government ditches are nearing completion. There are many under way, and wherever water flows or is planned to flow on the land through these systems can be found plans and prospects for establishing the beet-sugar industry. To be convinced of this one has but to travel over Colorado and Idaho or elsewhere among the valleys of the western mountains.

The installation of a sugar factory is always accompanied by the introduction of the most modern and scientific methods of farming applied to beet culture, and incidentally to other branches of farm industry. Intensive farming is taking the place of cattle and sheep grazing.

With the advent of more dense populations comes the demand for modern appliances and equipment. This leads to harnessing the power of the descending mountain currents to produce light, heat, and power. Through the ditches and over the wires come these modern agents of helpfulness to civilized man's industry. For ages the energy of these mountain streams has gone to waste. To the aborigine and the early white settler the shining whiteness of the snow caps in the distance meant only the decoration of the landscape. To the modern inhabitant it means a potency far reaching in the economy of human affairs. From these melting snows come streams leaping down to the valleys pregnant with energy to be applied by man in digging the ore from the mountains and extracting the metal from it, in speeding the wheels of transportation, in producing light and heat for the home and business house, and in furnishing power for use in manufacturing. To utilize this energy there must be population. Population must have a supporting agricultural industry. The establishment of beet-sugar factories not only makes it possible to utilize these great natural forces, but fosters one of the greatest and most profitable forms of agriculture.



## SUGAR REFINERS BECOMING MANUFACTURERS.

In this introductory survey I must not fail to recount the improvement in the business-status of the sugar traffic. It is well known that the forces involved in the conduct of a specific business tend to produce currents confined to well-defined channels. This is necessarily so, or all business would be erratic, panicky, and easily disturbed. These currents do not tend to deviation unless some unusually potent influence swerves them. A decade ago the beet-sugar industry received a great impetus. The sugar industry in this country at that time was largely confined to refining the product of foreign manufacturers. This business was built up; its lines were established. It became necessary, therefore, in installing the production of home-made sugar to conflict somewhat with the already established order of things. Conservatism, the balance wheel of well-regulated business tendencies, refused to respond immediately to the demands of this new industry. Its claims must be demonstrated, and unfortunately by new men. It was also true and unfortunate that the majority of these men were inexperienced in any phase of the sugar business. The intricacies of this industry must first be mastered by them. This was done. They paid for the process, but they learned their lesson so well that they were successful in demonstrating the merits of the beet-sugar industry to the refiners who were responsible for the established order of things. While these were the last to appreciate the merits of the beet-sugar industry, their conversion was probably the most helpful feature in its progress. It is well understood that the refining interests at present are extensively represented in many plants of the country, and some of the largest most successful factories operating in the beet-sugar industry. These same interests are actively projecting many other sugar plants. They are probably now among the most effective and energetic agents in advancing the home production of sugar. They build large up-to-date sugar factories, equipped with modern machinery. As a rule these new plants are being installed in the arid West, where the beets are grown on lands reclaimed by irrigation. They are fulfilling the two demands of civilization—establishing good paying business enterprises and promoting modern civilization by affording employment and sustenance to well-paid American workmen.

## THE OUTLOOK FOR FACTORY BUILDING.

I can report, as a further important feature which will culminate in the near future, the many mature and positive prospects for increasing the number of factories in this country. While at times there have been more rumors of factory building, there has never been a time from the inception of the industry when there were so many communities with well-matured plans for establishing factories. Especially is this

true in the irrigated districts of Colorado, Idaho, Wyoming, Montana, and western Kansas; and in Wisconsin, and, to some extent, Iowa, in the rain belt. There is a healthful revival of factory building throughout all the States now participating in beet-sugar production. It seems quite probable that two or three new States will be added to the list next year.

The mistakes made in the installation of factories due to overcrowding some farming districts, or on account of the inability or disinclination of farmers to furnish the beets for various causes, have been corrected. In most cases such factories have been moved to other places whose capabilities have been fully demonstrated in advance, where they are now in successful operation.

#### PRODUCTION OF ALCOHOL.

It has been demonstrated that sugar beets are highly productive of alcohol. Two of the leading chemists of this country, after exhaustive experiments, informed me that they could produce alcohol from them at a cost of 10 cents per gallon. France has built up an extensive industry in the production of alcohol from the beet root. Alcohol is produced at one place in this country on a large scale from the refuse molasses of the sugar factories. This throws a new light on the availability of sugar beets as a raw material for manufacturing purposes.

In regard to alcohol, in theory there appears to be great possibilities. It is claimed by chemists that a so-called "denatured" alcohol could be made, to be used solely for fuel and in the arts and sciences, by introducing other ingredients which would render the product absolutely useless for other purposes. It is claimed that there are more units of heat in a gallon of alcohol, costing 10 cents, than in 10 cents worth of any other kind of fuel.

Of course there are obstacles in the way. In addition to the revenue laws, there is the difficulty of coming in conflict with strong, well-established industries engaged in supplying articles of fuel. My purpose at present is simply to outline the possibilities. These appear to be enormous, for alcohol can not only be used as fuel but enters as an important ingredient in varnishes, paints, shellacs, and many other articles.

#### IMMIGRATION AND THE LABOR SUPPLY.

As an important factor in the progress made, I must call attention to the effects of this industry on the status of labor, not only that directly employed in this industry, but that employed generally throughout the rural districts where beets are grown. I have alluded to this in several earlier reports. We have generally drawn on Europe for a supply of immigrant laborers especially trained in the production of sugar beets. This class of workmen in this country is of many



nationalities, most of them, however, being Europeans. In the beet fields of Europe they have been receiving special training for this work for many years. Our wages are more attractive to them, as well as the opportunities of American life. The building of new factories constantly calls for foreign beet growers. With the increasing permanent demand for this class of labor, we are constantly receiving from Europe an additional supply. It seems to be a feature that gathers force as time continues. Each immigrant, after establishing himself, enters into communication with his friends at home. This eventually bears fruit in inducing others to follow.

The variety of nationalities represented in the beet fields is another thing that portends much, in that it opens up channels of supply from so many different sources. These broaden and become settled avenues of immigration. I wish especially to emphasize the favorable character of such immigrants. They come here with settled habits of industry, with an ambition to become a part of our progressive social organism. Some of them have small means for investment, while all have sturdy manhood. There is an absence of the features marking those immigrants known to our Government bureau as "undesirable." They are not the contract, criminal, or irresponsible class. They desire to better their condition and that of their families, who in time are assimilated, gradually leading to the improvement of our people. It was my privilege during the past summer to meet several advance agents of this class of immigrants investigating the beet fields of this country with a view to settling large bodies of foreign laborers. In effect this means colonization. Many of the workmen were represented to have a little money for investment in homes and land, and an ambition to increase their holdings by their earnings in this country.

Again I must call attention to the helpfulness of this industry. It must be remembered that work in the beet fields is confined mainly to the growing months of the summer. These workmen must provide themselves with employment as nearly as possible the year round. The advantage to farming in general, to factories, and to other lines of industry may readily be discerned. Possibly many of these workmen are drawn into other avocations from the start. Most of them participate in a different line of work during part of the year. The last ten years has developed considerable anxiety among farmers as to their labor supply. Our progressive system tends to an advancement in effort, rather than to fixing an avocation on a class, as in other countries. The American is more and more attracted to the trades and professions. To such an extent has this proceeded that the farmer has been left without a competent supply of help. This condition has been met all over the country. It has received attention from writers on agriculture and the press generally. Any industry that tends to attract a class of workmen back to the fields should be hailed as a

benefactor. The beet fields of this country are a standing advertisement in the agricultural labor districts of Europe for a labor supply which benefits all branches of industry, but especially agriculture. An industry which tends to counteract the depletion of labor in the rural districts must be classed as beneficial.

In the settlement of our new agricultural districts throughout the West we are repeating, in a way, what occurred in the Mississippi Valley some years ago. There can be found districts settled from the older eastern States. In Iowa, Kansas, Nebraska, and elsewhere, are settlements made up almost exclusively from particular States, such settlers being popularly known as "Knickerbockers," "Wolverines," "Keystones," "Buckeyes," "Suckers," "Hoosiers," etc. Probably each of these settlements started with a nucleus of a few families and grew to larger proportions by accretions from the respective home districts. While the same is true to some extent in the far West, we now have, in a more marked degree than ever before, settlements of Germans, Russians, Scandinavians, etc. We have large aggregations of laborers from the countries of southern Europe, all tending to work out the mission of the beet-sugar industry and, incidentally, to help all other enterprises.

In the establishment of a new beet-sugar enterprise assurance of a satisfactory supply of beets is an important prerequisite to success. When the necessary capital has been secured, a proposition is made to the farmers to contract for a sufficient acreage of beets to supply the factory for one to three years. Securing the capital seems to require the least effort of the two. The farmer is naturally conservative. From his experience he is aware that his labor supply has been gradually lessening and wages gradually increasing. This is true throughout the rural districts in all parts of the United States. There has been a gradual movement of laborers from the farms to the cities. It is hard for the farmers to conceive that the introduction of an institution of this kind, making large drafts upon labor supply, would benefit their general condition or that they are in a position to meet its demands. The difficulty, however, is more apparent than real. The labor supply of the farmer has been depleted by the tendency of laborers to leave the farm for the manufacturing industries. A beet-sugar factory must of necessity be located in the district where the beets are grown. As a rule it is not possible for it to be located in a manufacturing center. It is erected in a farming district. Every sugar factory makes an active organized effort to attract sufficient labor to perform the work on the farm and in the factory. The sources of supply are thoroughly canvassed and inducements are offered to bring the laborers into this field. Otherwise, the farmer, as a rule, would be simply dependent upon such laborers as presented

themselves asking for employment. Farmers are not organized for attracting and directing a supply their way. The factory is.

When a new sugar factory is installed, one of the first indications of the changes which are to follow is the arrival of train loads of laborers brought in from various places, generally persons of foreign extraction who are accustomed to doing work in sugar-beet fields. The sugar factory has agents who are active in directing laborers to its locality. When the factory's campaign is over, and the work in the beet fields is done, many of them engage in other work on the farm. In this way the sugar factory improves labor conditions in its locality instead of interfering with them.

I have often referred to the availability of school children, from the age of twelve up to maturity, for this purpose. The major part of the work in the beet fields must be done at a time when the public schools are out, and carloads of these young people can be seen early in the morning on Monday going out to the beet districts to return again Saturday night. This opportunity is a boon to every city and town within easy reach of a beet-growing district. Beets are grown at a time when the laborers can live in tents and board themselves, very little equipment being needed. Young people in these districts are afforded an opportunity of being more nearly self-sustaining by employing their time in weeding, thinning, hoeing, and harvesting beets throughout the vacations of the public schools. They are able to clothe themselves and furnish assistance in supporting the families of which they are members. The work is healthful, and it inculcates industrious habits. Such laborers are paid from \$1 to \$1.50 per day.

#### **CONDITIONS FAVORABLE TO THE ESTABLISHMENT OF THE BEET-SUGAR INDUSTRY.**

Environment has everything to do with the success or failure of the beet-sugar industry. It affects the facilities for producing sugar beets and disposing of them and the finished product, the cost of raw materials, transportation, and many other things.

#### **CLIMATIC CONDITIONS.**

Before assuming the responsibility of growing sugar beets for a sugar factory all the conditions must be thoroughly investigated and found favorable. In this connection we will first consider climate. It has been found, as stated, that sugar beets can be grown quite generally throughout the United States. It has been as definitely ascertained that beets may have the proper appearance and form and still not be adapted to sugar making. After all our experiments and investigations we are not able definitely to locate the beet-sugar belt, or, in other words, the area of country adapted to producing beets suited for the sugar factory. It has been found



that meteoric conditions exert important influences. The sugar-making qualities of beets appear to develop better under northern conditions than under southern. This is probably due to the effect of too long-continued constant heat received by the vegetable in the South during its growing period. It is quite generally agreed by scientists who have investigated this phase of the plant's growth that an average of 70° F during the growing season of the beet—estimated to be a hundred days—meets the normal requirements of the beet. Beets grown under such temperature show a much higher quality than those grown under considerably higher average temperature. Just how far such results may be modified by moisture conditions I am not able to state. Beets are grown successfully in California and Arizona and most of the arid valleys of the inter-mountain States.

In some of these areas they receive as much heat during the day as those grown in the lower half of the Mississippi Valley. Indeed, it is such districts that maintain the highest averages of sugar contents during the manufacturing season. While the amount of heat may be quite similar to that found in the Southern States, other conditions appear to exert a modifying influence. Throughout the beet districts of the arid regions the evenings are generally cool. This is usually considered conducive to root-crop growth, and it probably is effective in the elaboration of sugar. The heat received by the beets in the South is accompanied by a more humid condition of the atmosphere, while the air in the arid section is quite dry. Whatever conclusions may finally be reached through scientific investigation regarding the area best adapted to sugar-beet culture, practical experience has demonstrated that we have enough territory adapted in every respect to produce the sugar of the world and provide for the increase of consumption for years to come. It is now apparent that our capacity in this respect is practically unlimited as compared with any ordinary estimate of future consumption. To produce the world's supply of course is not our present ambition. We are concerned at present with the production of a supply for our home market. Barring possible exceptions due to local conditions, the territory north of the middle line of Iowa drawn east and west from the Atlantic to the one hundredth meridian and all the valleys of the intermountain and Pacific States known as arid or semiarid are adapted agriculturally to the production of beets for use in making sugar. There are also many places south of the line indicated in the eastern section that will probably produce them just as well; but in the area indicated experimentation has shown a general tendency to higher sugar contents as we approach the Canadian line. Through a series of experiments, and by noting actual results at the sugar factories, it has been determined that the sugar content of the beets increases with considerable regularity

from south to north in Michigan and Wisconsin. Some of the individual beets testing highest in sugar contents have been grown near the Canadian border from North Dakota to New York.

The decision of the farmer to grow sugar beets is determined largely by the presence or absence of a sugar factory. Questions involving climatic influences in different districts largely concern the factory itself. The conditions favorable to the sugar beet for factory purposes are now pretty well defined—probably as well as the conditions affecting corn or wheat. As far as climatic conditions are concerned, we are not liable to mistakes in location of factories. The factories themselves have been the most effective agents in working out definite conclusions. Of these we have a chain reaching up the western coast from Los Angeles to Spokane, demonstrating the existence of favorable conditions in California, Oregon, and Washington; and in the intermountain States there are factories from Arizona to Idaho accomplishing the same work in Arizona, Utah, Montana, and Idaho. In the States producing crops by rainfall we have another chain of factories, reaching from Nebraska to New York, demonstrating field conditions for growing beets in Nebraska, Minnesota, Wisconsin, Michigan, Ohio, and New York. For some of the factories in all of these States beets are grown in adjoining States or Territories. In this way we have secured a complete demonstration of practical conditions in the whole beet-growing area. Future growth of the industry will simply be based on known conditions. Experience and investigation have accomplished much for the benefit of this industry. It was the important feature lacking in the beginning of its development.

#### CONDITIONS FOR SECURING FUEL AND LIMESTONE.

Climatic influence is not the only important feature to be considered in the establishment of a beet-sugar factory. The locality may have ideal conditions in this respect and yet not be suitable for a sugar factory. This is a fact that has been demonstrated in the past by actual operation of the industry. There are many things necessary for promoting the facilities of sugar manufacture. In producing sugar from beets certain materials must be used which affect the cost of production. These are fuel, limestone, and other factory supplies. It must be apparent that the cost of fuel varies widely in the different parts of the country. If coal is used it takes an amount equal to about 20 per cent of the weight of beets to manufacture the sugar. This makes an important factor in the cost of production. Its cost in some places would be prohibitive. This condition may be overcome to some extent by the use of other material for fuel. In California the fuel used in the sugar factories is largely crude oil. The same will probably be true in Kansas in the new factories that are to be established there. In Washington up to the present time wood has been largely the fuel

for manufacturing purposes. Most of our factories, however, are located near coal deposits affording cheap fuel.

Of lime rock, a sugar factory consumes an amount equaling in weight from 9 to 11 per cent of the beets worked. The factory should be able to secure a supply of this material as cheaply as possible. In quality the lime rock should be good, with as little as possible of silicates, magnesium, and some other ingredients usually found in lime rock. That which carries the highest percentage of carbonate of lime is most desirable. Our factories generally throughout the country are favorably located for securing a cheap and suitable supply of this material. The ease with which other needed materials may be secured by a sugar factory depends largely upon its proximity to good commercial centers. Of course the securing of these miscellaneous supplies is of smaller importance, but is worthy of consideration in estimating the cost of production.

#### TRANSPORTATION AND MARKET FACILITIES.

Transportation facilities, whether by rail or by team, have much to do with the successful operation of a sugar factory. The more railroads the better, and it is better still if these roads approach the factory from several directions. This promotes the delivery of beets and other crude material to the factory and the carrying to market of finished products. It very much extends the beet-growing area, as it makes more localities accessible by rail. The same thing may be accomplished by the building of trolley lines throughout the beet-growing district.

Good country roads are an important feature in the operation of a sugar factory. In order to reduce the cost of delivery of beets to the factory, farmers should be able to haul large loads. They usually deliver loads of two to four tons. This requires that the roads be in the best condition as to grade and repair. Six miles is generally considered the outside limit of wagon delivery. When we get beyond this distance we find that farmers consider the long haul of the beets a serious obstacle. Seventy-five miles by rail seems to be the practical limit. Beets are delivered at greater distances than these by wagon and by rail, but beyond the distance limits named the propriety of attempting to extend production is a debatable question.

Much depends upon the market facilities of the sugar factory, its proximity to good-sized towns or commercial centers, and the competition with which it has to deal. Much also depends upon its transportation facilities and the sympathetic relation existing between the factory management and that of the railway. The greater part of the demand for sugar in this country comes from the area lying east of the Mississippi River. Through lines running east and west generally promote better market facilities.



## IRRIGATION AND SOIL CONDITIONS.

In a large area of the country where sugar beets are grown an irrigation ditch furnishing throughout the growing period a full and suitable supply of water is a prime necessity. In fact, this is the basis of all agricultural production. Such ditches must furnish a supply of water that will be ample, regular, and permanent. Sometimes it happens that the source of the irrigation water becomes affected by drought, which reduces the quantity of water flowing through the canals and ditches, thus giving a scant supply to the grower at the time when he needs it most. It often happens that the laws and regulations governing water rights are bad. The value of a water right depends largely upon the date of its establishment. As the amount of water becomes less through any cause, the shortage affects those rights of most recent establishment first. There are many intricate and troublesome problems affecting the use of water for irrigation.

As the subject of irrigation is more fully discussed elsewhere in this report (pp. 42-43), it is only necessary here to say that all conditions affecting irrigation should be carefully investigated before an attempt is made to establish the beet-sugar industry in arid sections.

The character and condition of the soil as affecting the growing of the beets must also receive careful consideration; but it has been demonstrated that there are no narrow soil limitations affecting the establishment of this industry. The sugar beet thrives over a wide range of soils provided proper cultural methods are used. Soils and methods of treating them are more fully discussed in another part of this report (pp. 20-24).

**SUGAR BEETS AS FOOD FOR LIVE STOCK.**

Sugar beets have an important place as a field crop aside from their sugar-producing qualities. Grown as a stock beet, they rank among the first of the root crops which may be used for animal food. They may be fed to hogs, sheep, fattening steers, growing cattle, milk cows, and brood mares. Results of feeding experiment show the following facts: Fed to cows, they increase to a remarkable degree the flow of milk; they promote the fattening of cattle; they not only add materially to the nutritive value of the ration, but they have a sanitary effect in the promotion of digestion. In the feed yard containing a lot of steers fattened on a ration of corn and beets, one can observe very little of undigested grain in the droppings. In this particular the effect of beets is the same as that of pulp. They produce a better quality of meat, as has been shown on the block in many experiments. This applies to pork as well as beef. We find that the steak or the roast is more firm, juicier, and better flavored. These qualities have been noted in the famous roasts and chops of England and Scotland,

produced by feeding mangel-wurzels, turnips, rape, and other succulent root and green vegetable crops. In recognition of some of these facts, I reproduce here what was said by one of the leaders of the Fat Stock Association of Chicago, in a recent interview in Denver, reproduced by the Oklahoma Journal, Oklahoma, September 25, 1905:

Hogs fed on sugar beets make the finest kind of meat, according to Nelson B. Morris, the millionaire Chicago packer, and they command the best prices in the markets. As Colorado is one of the leading States in the production of sugar beets, it means the opening of practically a new industry for that State—that of raising hogs on a large and profitable scale. Colorado can raise more than enough to supply all the sugar plants and to feed thousands upon thousands of hogs. Sugar beets can be raised very cheaply and it will make the raising of hogs a profitable industry. The climate here is also adapted to hogs. "Colorado is admirably adapted to this industry," said Mr. Morris, just before he boarded the afternoon train for Chicago. "This State grows alfalfa, sugar beets, and field peas in abundant quantities, and these are the finest kind of feed for hogs. Colorado should produce the finest hogs in the world."

Outside of the corn belt Mr. Morris declares that there were three great forms of food for hogs which make their flesh firm and develop them in every way into valuable animals for the block. These, he said, were alfalfa, sugar beets, and field peas. These are most valuable as hog foods.

This shows that men of practical affairs are learning what men of the theories have long ago demonstrated by actual experimentation. It would pay any farmer to grow sugar beets and store them for feeding to his farm animals of all kinds. There is too much feeding of grain, especially corn. For this should be substituted a helpful food ration in which root crops form an important part. No better root crop can be used for this purpose than sugar beets. This fact is being demonstrated in feeding experiments at many agricultural experiment stations throughout the United States, and it is being demonstrated by practical feeders and extensive producers of live stock. They are being appreciated more generally by farmers over the country. It was my observation several times during the past harvesting season to note, among other difficulties of sugar factories, that they were losing some of their beets; these were bought up by the farmers for feeding purposes as they were being delivered to the factories. In order to secure the beets, the farmers must necessarily pay as much for them as if delivered to the factory, barring, of course, in some instances, the cost of delivery, the farmer taking the beets from his neighbor, the grower.

As a field crop, for feeding purposes, the sugar beet affects almost the entire country. In the West it makes possible the establishment of the feeding industry in all irrigated districts. A short time ago it was only possible for this western country to prepare stock cattle and sheep for eastern feeders. It contributed to the stock industry only so far as the range could do the work. Hog raising was practically



out of consideration. With the development of irrigation came alfalfa, the field peas, barley, and other cereals, followed by sugar beets, and, in districts having sugar factories, sugar-beet pulp. These stock feeds form a basis for stock rearing and feeding in competition with other States farther east.

When the feeding possibilities are demonstrated, it is easy to see that the foundation is laid for the establishment of the dairy and creamery. When I began the work of investigating this industry nine years ago, the people of the intermountain and coast States bought from producers in the Mississippi Valley and farther east most of their butter, cheese, poultry, prepared meats, and eggs. It is one of the strong probabilities that in the near future these eastern and central States will find in their own markets strong competition coming from farther west.

In my previous reports I have often urged a more general growing of sugar beets purely for feeding purposes. I have suggested three benefits from such practice: (1) It adds materially to the economy of the farm, improves the soil, and introduces better and higher methods of tilth; (2) it furnishes a valuable addition to the supply of feed for live stock; and (3) it educates the farmers in beet growing, thus creating one of the favorable conditions for a sugar factory. By those best posted in stock rearing, it is conceded that farmers are generally too much given to feeding grain, which, fed alone, is too heating and has a tendency to cause digestive disturbances and diseases of various kinds. It has been thought by some that an exclusive ration of corn has a tendency to promote hog cholera. Practical feeders have found that better results can be accomplished by introducing a root crop into the ration, and sugar beets have been especially favored for this purpose.

I have found that some confusion has arisen owing to the limitations governing the production of beets for sugar making—as, for instance, those relating to climatic conditions, size of beets, etc. These limitations apply only to the production of sugar beets for factory purposes and not to growing them for general farm use. They are based entirely on the purity and sugar content of the beet. They do not apply to growing them for stock food. This leads to the further explanation that the cost of production of stock beets is not nearly so great as that of beets for sugar making. The yield per acre should also be very much higher. A farmer who is growing beets for a factory is generally admonished to produce a beet of comparatively small size. This requires time and expense. The cultivation and care throughout is more expensive. Then the delivery of the beets to the factory—one of the leading items of expense—is entirely eliminated when growing beets to be fed on the farm.

Another benefit which comes from growing sugar beets for feeding purposes is the familiarity it gives the farmer with the conditions and methods of culture. The area which possesses proper conditions for growing sugar beets for factory use is extensive. Sooner or later the farmers throughout this area are likely to be asked to grow beets for sugar factories. Without a familiarity with the crop, a farmer is utterly unable to form a wise conclusion on the subject. But growing beets for his stock gives him an opportunity to gain practical information that he can not gain in any other way. Some of the few great mistakes made in this country in the installation of beet-sugar factories resulted from the total absence of experience of this kind. It is gratifying to report that farmers are taking more and more interest in this phase of the subject. I have known some farmers who, after growing the beets for the factory, have preferred to feed them, or a portion of them, rather than deliver them to the factory. Many farmers who grow beets for the factory grow other beets specially for stock. I find in farming districts where there are no sugar factories that the number of farmers who grow beets as a regular crop for feeding purposes is becoming more numerous every year. I feel like insisting that those who have not done so should give this practice a trial.

### **SUGAR-BEET CULTURE.**

#### **THE SOIL AND ITS TREATMENT.**

Let us now assume that the problems involving general conditions have been disposed of for the farmer by the location of a sugar factory in his vicinity. He has contracted to grow the beets. He is now face to face with certain problems directly affecting him. The first step of prime necessity is the selection of the soil. Upon this depends much of his future success in the business. If he is a thoughtful farmer, he will eventually make a programme for a rotation of crops and decide in advance what particular land he will devote to sugar-beet growing for several successive years. Some crops precede beet growing better than others and are more effective in leaving the soil in proper condition for planting beets. Such crops permit fall plowing, and this is generally preferable. This plan will also embrace all the crops to be grown in the rotation for several years, and have in view thorough practical fertilization of the land a year or two preceding the putting in of the beets, especially if the fertilizer to be used is ordinary farm-yard manure. These things are merely incidental to choice of land. We are concerned at present more directly with the selection of the soil itself. That selected for planting to beets should be what the farmer considers the strongest and most productive on his farm. If his whole farm consists of this kind of land, then he should grow sugar beets at some period on all parts of it. If it is not, he should

confine himself to what he knows to be the most productive—that upon which he produces his best yields of corn, potatoes, and other field crops. With sugar beets, the kind of soil is not of prime importance. They do well in sandy loam, clay loam, or what is known as clay soil. But whatever land is used must be fertile and capable of being stirred to a considerable depth, say 10 to 12 inches. Sugar beets will not do well in soil underlain with hardpan. Their tap roots strike down to considerable depth. The soil should be of a nature which permits of constant cultivation, one that does not become so compact and hard as to interfere with the cultivation or harvesting of the beets. The harvester of sugar beets, whatever kind may be used, must go down to a considerable depth below the surface, in order to break the tap roots of the beets and lift them. I have seen fields planted to beets which became so hard and compact by harvest time that it was almost impossible for three or four horses to pull the harvester through the ground. The soil must be of a kind that will permit thorough pulverization. This is necessary for preparing the seed bed. The beet must imbed itself in the soil and not be found projecting from the surface at its maturity. Cloddy rough ground, stones, stubble, stumps, etc., tend to prevent the beets from growing as they should. They not only cause the beets to grow above the surface, but make them sprangle and assume an unnatural form. To secure best results, the beet should have a regular tapering form, with its taproot growing directly down. Anything that causes the taproot to divide into two, three, or more branches simply produces a poor beet.

In naming the kinds of soil suitable for factory beets I have had in mind more particularly soils of the rainfall sections of the country. Out in the valleys of the Rockies and the Sierras we have altogether a different kind of soil with a great many varieties, largely of silt formation, resulting from disintegration of the rocks of the higher eminences. These have been found generally adapted to beet growing, providing sufficient moisture can be applied. Sometimes strata of rock near the surface or heavy deposits of alkali may interfere with the growth of the beets. It has been found quite often that the surface shows very little indication of alkali, but on the application of irrigation water the alkali is brought to the surface to such an extent as to interfere with vegetation. Extensive experiments in "leaching" such soils are being conducted in some places. This is accomplished by tiling the land thoroughly and washing the alkali out of the soil by irrigation, allowing the subdrainage to carry it away. Much valuable land is being recovered in this way. Sugar beets are not especially susceptible to injury from alkali in the soil. In it they thrive better than many other field crops. In some places where beets are grown the atmosphere is very dry and evaporation takes place very rapidly. In the early part of the beet's growth they seem to thrive excellently



with no noticeable effects of the presence of alkali, but as the season progresses the sun becomes very hot and evaporation takes place very rapidly. This has a tendency to increase the relative amount of alkali in the water which reaches the rootlets of the beet. The effect of alkali in such cases becomes very marked, and is quite deleterious.

I have stated that sugar beets are adapted to good fertile soils generally, but this applies only to those that have been thoroughly reclaimed. Beets are not a good pioneer or reclamation crop in a general sense. It is of paramount importance in producing beets for factory purposes that they should be kept up to a high sugar content and purity. The former refers to the amount of sugar contained, and the latter to the relative amount of sugar as compared with other solids in the beet. Beets should not be planted on new lands, especially cleared lands, full of decaying vegetation, until these have been thoroughly reclaimed by cultivation, because on such lands there is a notable tendency to grow a good vegetable but of low grade for sugar making. The same tendency occurs on low, damp, sour lands unless they are thoroughly drained and given sufficient time for complete reclamation by cultivation and cropping. Corrals, barnyards, and feed lots broken up and planted to sugar beets are liable to produce beets of low quality and should be avoided. While these are especially adapted for potatoes and corn and many other crops where quantity is the special object, they are not productive of the desired quality in factory beets. The important things to be kept in mind in selecting the soil for sugar beets are two—quality and quantity of the crop. There is no question but the farmer has a prime interest in the quantity of beets grown upon his land. For this reason he is advised to plant on good fertile thoroughly reclaimed land. At the same time he is under contract to produce beets of sufficiently high quality to meet its purposes. Granting that he has accomplished this, then it is to his interest to produce the greatest possible yield of beets from his land. It is probable that he will be able to grow a good quality of beets on most of his land, but in order to compensate him for his effort and the high expense of the beet crop, he must grow the quantity. At the ordinary prices paid for beets by the factories throughout the country it takes 6 or 7 tons per acre to pay the cost of production. It is as evident as it is logical that a farmer can not expect a profit in growing beets on land naturally low in productive power, and the experiment should be avoided. Beyond the cost of production the profits accumulate. An average of 10 tons would give him a net profit of, say, \$20 per acre; of 12 tons, \$30 per acre. Estimating cost of production at \$30 per acre, the average grower of the United States for 1903 realized \$12.40 per acre, net profit; in 1904 he realized \$22.35 net profit. If we take the average yield of almost any other field crop

and value it at the average selling price and deduct the cost of production, there will appear but very little profit in the business, and in some cases there will be an actual loss.

In considering this matter it must be held in mind that under present conditions there are many factors entering into the estimates of yield and profit in sugar-beet production that do not enter into the same calculations regarding other crops. We must consider the number of new farmers each year producing sugar beets without former experience, the area of new lands upon which beets are grown for the first time, the scarcity of farmers who have been sufficiently educated in the methods which produce best results. Better results will occur when factories become more numerous, the growers have had more experience, and the better class of growers predominate. As time passes there should be a gradual tendency to rise in the average yield of beets and in the amount of sugar they contain. There should also be an equally decided tendency, through the results of experience, toward a lower cost of production. The farmer will realize more per acre on account of the greater yields of beets, more on account of their greater sugar content, and more on account of lessening the cost of production. This is not theory; it is the actual recorded history in Germany, France, Austria-Hungary, and all other beet-sugar countries which have gone through extended experience.

#### PREPARATION OF THE SOIL FOR BEETS.

Preparation of the soil begins with the arrangement of the cycle of rotation. It is continued during the years of cultivating other crops leading up to the planting of beets. The fertilization of the soil in connection with these other crops is an important step in this preparation. It is good practice whenever possible to fall-plow early and deep. This is especially commendable wherever freezing of the soil takes place. This has a pulverizing effect on the soil and promotes the availability of its plant food. Just before planting, the ground should be given a more shallow stirring. It should be thoroughly harrowed and rolled to pulverize it and compact it. It should be cultivated up to planting time in order to expose the germinating weed and grass seed and destroy them; also, to prevent evaporation of its moisture. Cultivating, harrowing, and rolling are not expensive features when we consider the comparatively small area of ground devoted to growing sugar beets and the amount of land that can be treated in this way by one man and a team.

The best time to kill weeds and grass is when they are young, as soon after germination as possible. This is their tender stage. Weeds and grass, like other plants, after germination do not have as much ability to perpetuate themselves as farther along in life when the plants have developed better root systems. For this reason, we

insist on early stirring of the ground, constant harrowing, and cultivating and rolling (if necessary) up to the time of planting. The beet plants should be given as nearly an even start with the weeds and grass as possible. All of this work lessens the work and the cost of cultivating after the plants are up.

Much depends on the condition of fineness and pulverization of the soil at the time of planting. What has been said of the delicacy of the weed and grass plants at the time of germination is more true of the beets; and, like them again, the beet plant is very hardy after it has passed the first two or three weeks of plant growth. After this it is one of the most hardy plants to be found in the cultivated fields. On the condition of the seed bed depends much of the performance of the crop. In the first place, the cultivations up to the time of planting have conserved the moisture in the soil. If a dry spell should begin at this particular time, the moisture previously in the earth has been preserved for the use of the growing plants. If the soil has been finely pulverized, it will compact up closely around the seeds, conforming to their rough exterior. This enables them better to extract moisture from the soil. If the ground is cloddy or of a coarse granulation, the circulation of the air around the seeds in the soil deprives them of the moisture necessary to germination. This retards and may prevent germination, causing a poor stand. Replanting is always unfortunate to the beet crop. It adds to the expense for both seed and labor. It gives the weeds and grass the start of the beets. Or, let us suppose that the seed has been planted in cloddy or coarsely pulverized ground, that germination has taken place, and that the weather is unusually dry. The young rootlets reaching out from the seed, seeking moisture in a coarse open soil, are killed by the effects of the hot, dry air. This produces the same result as if the germ had been actually killed in the seed before it sprouted. A pulverized compact soil serves greatly to counteract all this. When the young plant begins to send out its rootlets, it is much better protected. These immediately strike out into moist soil, and the conditions are favorable to successful growth.

#### PLANTING THE SEED.

When the seed bed is properly prepared, the farmer should plant his beet seed under the most favorable weather conditions. The ground should be sufficiently moist, and there should be sufficient warmth to sprout the seed. If the soil is prepared in time and kept in proper condition, the farmer will be able to seize the first favorable opportunity for planting. If beet seed are planted in ground that is lacking in moisture, the beets will come up unevenly. No ground is uniformly moist after being subject to the action of the sun and winds for a period of time. If beet seeds are planted in



soil that is more or less dry, some sprout and come up; others lie dormant, waiting for sufficient moisture. The beets appear irregularly. They come up in spots. Some of the plants push ahead; others are delayed. Such variations will occur in many places in the same row. The farmer finds himself cultivating old and young beets at the same time. In districts where beets are grown by rainfall, the farmer can decide on the proper time for planting by carefully watching the conditions of the soil after rains. In an irrigated district, if it is too dry when he is ready to plant, he gives the soil irrigation, cultivates it, and plants while he has it in the proper shape. This is called "irrigating up" the beets. It is not generally considered desirable, but it is much better than taking hazards in the presence of a dry spell of weather.

Planting is effected by implements called "seeders," specially designed for this purpose. It is the common practice to plant 20 pounds per acre. To the casual observer this might seem like too much seed; but to one long experienced in growing beets it is known to be a necessary safeguard. It is true a great many more plants come up than will be necessary. Sowing 20 pounds of seed to the acre brings the seeds very close to each other in the row. At the same time each seed contains from one to six germs, each of which may produce a plantlet. The purpose is to have enough beets at regular distance in the row after extracting superfluous plants. There are so many things interfering with the germination and growth that it is hazardous to plant a less quantity of beet seed. The importance of a stand is too great to sacrifice it for economy in cost of seed. An extra half-ton of beets resulting from a superior stand will more than pay for all the seed used. We can not afford to quibble over an extra 50 cents or \$1 for beet seed.

The seed should be planted from one-half inch to 2 inches deep according to circumstances. Natural conditions in some localities require planting to a greater depth than others. Circumstances modify at different times the depth to which beet seeds should be planted, even on the same land. I believe as a rule irrigated lands require planting to a greater depth than those growing beets under rain conditions. In the latter if the ground is thoroughly moist and warm, a half an inch is preferable. Under such conditions beets will have time to germinate and send out their roots before the surface can dry out. If there is any likelihood of drying, or if the seed must be planted when the soil is not sufficiently moist, they should be planted deeper. Where lands are watered artificially, weeds are not so troublesome as in rain districts. There are not so many outlying places growing weed and grass seeds to be distributed by wind over the cultivated lands. The deeper we plant the beet seed, the longer it takes for the plants to appear above the surface and the better chance the

weeds and grass have to get ahead. The depth to which beet seed should be planted must be determined on the spot at the time according to the conditions.

#### BREAKING UP THE CRUST.

Tender plants will not thrive where the surface of the ground is compacted or "baked." Even if directions have been followed, the ground constantly cultivated—rolled and harrowed—up to the time of planting, a beating rain is likely to "bake" the soil before the beets come up or soon after. I have seen cases where beet plants have made an energetic effort to come up but have failed on account of the hardness of the crust. Something must be done to overcome this. In one case of this kind some of the farmers became discouraged, plowed up the land, and planted corn; but others put on harrows and rollers to break up and crush the surface and allow the beets to come through, and in this way they secured a good stand of beets. The rain had wrought both good and evil. It had supplied sufficient moisture for perfect germination, but at the same time it had compacted the soil and prevented the egress of the young plants. The harrowing and rolling remedied this. Even when the young plants are through the ground if the soil is compact the harrow should be used with the teeth sloping back to break up the surface. Possibly some of the plants will be destroyed by this, but it must be remembered that this work is done before thinning out takes place. At all events the crust must be broken up. The existence of a crop of beets depends upon it. Then if a sufficient stand of sugar beets is not secured there will still be time enough to replant or devote the land to something else. A proper economy of the farmer's time and land demands that he make an intelligent effort to overcome this difficulty.

#### BUNCHING AND THINNING.

As a rule the plants should be 7 or 8 inches apart in the row. Bunching is accomplished with a short-handled hand hoe of proper width. With a single stroke most of the surplus plants are removed from the row, leaving the beets in bunches at proper distances apart. From each of these bunches all the plants are removed but a single one. The aim is to leave the most perfect and hardy plant standing. This thinning is done by hand. The operator must, as a rule, get down on his hands and knees, secure firmly in the fingers of one hand the best plant that is to be left, pressing it down moderately. With the other hand the other plants are grasped and extracted from the soil. Whatever weeds and grass may be present should be removed also, and the soft dirt should be pressed around the remaining beet. This work is tedious and necessarily tiresome, as the operator proceeds along the row on



his hands and knees. But it is a very necessary part of the work, and much depends upon the care with which it is done. The grower should take possession of the situation here and never leave off until he has mastered it. There is a time for thinning beets which is most conducive to the success of the crop. This work should be accomplished at this time and not allowed to wait or drag along. Every day adds to the labor of doing it and to the bad effects consequent upon the thinning. It has already been said that a beet seed may contain several germs. These may all sprout, and the roots of the young plants may be more or less entwined. Taking out all but one must necessarily injure its roots to a greater or less extent. The injury should be made as little as possible. This injury is greater if the surplus plants are allowed to remain after the proper time for thinning has come. This delay will also retard the growth and weaken the vitality of the plants which remain, making them more susceptible to injury from insects, diseases, weeds and grass, and drought.

Continuous rains often interfere with bunching and thinning. This often gives grass and weeds a start and allows the plant to become firmly rooted before thinning is accomplished. After the plants have begun to show three leaves bunching and thinning should begin and be rushed through as quickly as possible.

#### CULTIVATION.

Cultivation of field crops has in view two principal objects: (1) The conservation of the moisture in the soil and (2) the destruction of weeds and grass.

It is evident that the supply of water to be consumed by the plant is of supreme importance. Where beets are grown under rain conditions the grower must understand in case of drought how to conserve to the best advantage the rain his land receives. In case of excess of rain he must know equally well how to remove it to prevent deleterious effects.

In the rain districts, so far as the amount of moisture the plant receives is concerned, we generally assume that human effort counts for little. A careful study of the case will reveal that the individual is a factor of considerable moment in modifying these conditions. In case of excessive rain relief is found through an intelligent and systematic surface or subdrainage. This every farmer should provide for when the land is subject to excesses. In case of scant rainfall or drought the bad effects may be modified by proper systematic cultivation. It too often happens that when a farmer's land becomes dry he ceases to cultivate. Yet this is the time when cultivation should be most regular and constant. This is especially true in the growing of sugar beets. They are vigorous, have a deep and broad root system, and are extensive users of water. Constant cultivation prevents evaporation of the moisture in the soil.

In talking to beet growers I often express it in this way. It is the natural tendency of the soil to form little connecting and capillary tubes ramifying through it and penetrating down to more or less depth. These tubes connect with the surface. The currents of air moving over the tops of the tubes evaporate the water in their surface end. Capillarity pumps more from the soil below through the tubes to take the place of that consumed and soon exhausts the supply. Cultivation prevents this. It breaks off the tops of the tubes in the general crumbling of the soil at the surface and covers them over with a dust mulch. It prevents this action of capillarity and evaporation. This system disturbed soon begins to adjust itself again, however. Therefore cultivate constantly, keeping this surface capillarity broken off and covered up with this dust mulch, preserving the water in the soil for the use of the plant.

We cultivate to stop this evaporation and in this way we conserve the moisture. Cultivation not only preserves the moisture during the time of plant growth, but, if the former cultivation has been properly done, it very much increases the amount of moisture which the soil will take up. It must be clear to anyone that, where the ground is loosened by deep plowing, or by subsoiling, considerably more water will penetrate and remain than where the ground is hard and packed.

Cultivation really begins with stirring the ground, and is continued through the various stages of preparation until time for planting. After the beets are planted, the harrow should be kept going. As soon as the beets appear sufficiently to indicate the outline of the row, cultivators with flat knives, like those generally called "goose feet," should begin the work of cultivation. As the plants get older, these flat knives should be removed and others for deeper cultivation should be used. Cultivation should be kept up as regularly as possible, as it not only removes grass and weeds, but by forming a dust mulch, it conserves the moisture in the soil; therefore, the drier it gets, the more we should cultivate. If necessary, hand hoeing should be resorted to. But it should be the aim to accomplish as much as possible of this cultivation work with the aid of a horse and cultivator. The amount of hand work necessary will depend upon the amount and persistence of the weeds and grass. In the first cultivation plow shields or "fenders" are necessary to keep from covering the beets. It is not permissible to cultivate as close to the row as when the plants are larger. As the plants grow the cultivator is run closer to the row, stirring the soil and throwing around the beets the fine pulverized earth, covering the young weeds and grass, and preventing evaporation from the soil. In Europe a great deal of hand work is given to beet production; possibly more than would be needed if modern implements and horse cultivation were more generally employed. Partly, no doubt from force of habit, the old country insists on hand work, but hand work can not be

necessary when horse power and implements will accomplish the same purpose. These very much increase the amount of work that a single laborer can do. I can see no reason for hoeing except to exterminate grass and weeds. There comes a time when nothing but a hoe will accomplish the purpose. Then it is advisable to hoe, but under no other circumstances. If cultivation has begun early and has been continued constantly through the preparation of the seed bed, planting, bunching, and thinning, horse cultivation will generally fill all the requirements.

After the beets have grown to such a size that the leaves touch between the rows, further cultivation with a horse is likely to do more harm than good. Later cultivation should simply consist of pulling by hand the weeds that appear above the beets.

The beet field receives another and very valuable cultivation when the beets are harvested. It is then ready for planting corn or other cereals, potatoes or other root crops, or being sown to clover and grass.

#### HARVESTING AND DELIVERY OF BEETS.

Harvesting requires as much care and intelligence as any part of the process of producing the crop of beets. It should be done in as thorough, businesslike a manner as possible.

The cleaner the fields at harvest time, the freer from weeds and grass, the easier will be the work. The looser the ground—provided it is not actually wet and soggy—the better for harvesting beets. It is first necessary to determine the ripeness of the beets. The grower familiar with the action of this crop can readily determine its stage of maturity. The leaves take on a tinge of yellow and show a tendency to droop. This yellow condition becomes uniform throughout the field. But we need not depend entirely on appearance of beets, because a few samples picked here and there and delivered to the factory will determine definitely the stage of maturity of the beets. The chemist of the factory will analyze them to ascertain their sugar contents and purity, and by these determine the condition of the beets.

Every well arranged sugar factory has an expert agriculturist whose business it is to arrange contracts with the farmers who grow beets. In this contract is a provision, giving the agriculturist certain supervision over the beet fields during the growing season. He is the officer who represents the factory's interest in the beet fields, determines the seed to be used, and furnishes it to the farmers. He notifies farmers when beets are ripe and when to deliver them to the factory. In fact, he has charge of all features of the factory's intercourse with farmers. Every beet grower should keep in touch with this officer. From the very nature of things, he must be especially informed on all matters relating to successful beet production.



At the earliest opportunity after beets are ripe they should be harvested. There are always hazards attending beet production at every stage of the growth. At harvest time there is the likelihood of rains or freezing of the ground. In case of excessive rains the beets send out new rootlets, produce new leaves, and start growth generally. When a beet is growing, it is not nearly so high in sugar contents or purity. In case of heavy soaking rain followed by warm growing weather, a beet crop ready for the harvest may be thrown in a short time into a condition rendering the beets unacceptable to the factory. In many cases this makes it necessary to let the beets stand longer to allow the weather to change, the ground to dry out, and the beets to again assume proper condition for harvest. In the northern beet districts—as in New York, Michigan, and Wisconsin—as the harvesting season progresses there is always a liability of the beets freezing in the ground, which stays permanently frozen until spring. In this case the beets are lost altogether. There is a tendency in all districts also for the ground to get very dry, becoming hard and compact. In this case the process of harvesting becomes more difficult. It is good practice to harvest beets as soon as the farmer receives proper notice from the factory that his beets are ready.

All sugar factories have definite capacities for working beets, and it is plain that all of the beets can not be worked at once nor received at once. When the bins of the factory are full, the harvest should continue just the same, but the beets should be siloed. Factories usually pay more for siloed beets than for those delivered directly as harvested. This is on account of their inability to take care of the beets and the extra expense incurred by the farmer in siloing them. It is also to encourage the farmer to harvest his beets at the proper time. Siloing is accomplished by piling the beets in the field in ricks having a base about 5 feet in width and tapering to a height of about  $4\frac{1}{2}$  feet. Often they are placed in piles of the same dimensions. A few furrows are thrown up on each side of the beets with the aid of a stirring plow. From this loose dirt a coating of 3 or 4 inches of earth is thrown over the beets. Later if the beets must stand into the colder freezing weather some sort of covering material is thrown over the dirt, such as the leaves of beets, straw, or old hay, and more dirt is thrown on top of this. This will protect the beets, as a rule, to the close of the factory's campaign or to such time as they must be delivered to it. Usually some sort of ventilation is arranged in the top of the rick or pile. This is in order to prevent the beets from being too closely confined, which promotes fermentation and decay. This covering is not so much to protect the beets from freezing as to prevent them from drying out or freezing and thawing. A factory does not object seriously to a frozen beet, provided it can be kept frozen until it is worked. Freezing and thawing is the objectionable thing. This



causes inversion of the sugar to take place, fermentation is started, and the beet is rendered useless for the factory's purpose. If the beets are placed in piles and not covered, they will dry out, become wilted, and lose a considerable portion of their weight, and the farmer becomes a loser thereby.

There are several different kinds of beet plows or harvesters. Those in ordinary use are designed to break off the tap root of the beet where it is small and lift the beet 2 or 3 inches, leaving it in an upright position in the loose soil so that it is easily picked up by hand. Some of these harvesters are shaped much like a stirring plow with long slender mouldboard and sharp share moving under the ground at a depth of 13 to 15 inches. Others in their general form above the ground resemble the plow, but instead of having the mouldboard and the share they have two upright parts passing on either side of the row of beets. These at their lower parts have two round horizontal prongs, one passing on either side of the beet. These prongs approach each other near their rear ends. The beet in this way is made to pass through a constantly decreasing crevice, and is thus forced upward until the tap root is broken off.

In covering beets, grass, old leaves, straw, or hay should never be applied to the beets first. It is good practice to use loose dirt for the first covering. If the straw, leaves, or the like are placed on the beets first and followed with a coating of earth, the pressure of the earth causes the straw covering to adhere to the beets. After standing for some time it is quite difficult to remove this trash from the beets. So strong is its adherence that, even after the beets have been soaked in water in the channel through which they are propelled to the washers and elevators, particles still cling to the beets. These seriously interfere with the whole process of cleaning and slicing the beets. Covered first with dirt, then with straw, the beets should be allowed to stand until it can be determined whether they must remain in the silo for a considerable time. If they must, for further protection an additional covering of dirt is thrown on the straw. The straw covering between the two layers of earth affords a better ventilation, also an air chamber which aids in withstanding the action of frost.

In connection with harvesting the question of tare comes up. There is a wide difference in the tare on different deliveries of beets. This is due largely to the condition of the soil from which the beets are harvested. Tare is made up from adhering particles of earth. In sandy soils the earth does not cling as in clay soils, nor in dry soils so much as in wet soils. Some beet growers take more care to remove the dirt before loading the beets than do others.

After the beets have been loosened by the harvester a workman follows and catching up each beet in one hand holds it firmly while by one stroke with a topping knife he removes the crown at the "sun

line," or the line which was coincident with the surface of the ground. The beets are then usually thrown in piles to the left or right, forming a string of piles across the field, but sometimes they are thrown directly into wagons. If thrown in piles, wagons are driven along by the side; the workman picks up two beets, one in each hand, bumps them together slightly in order to jar off the adhering dirt, and throws them into the wagon. Upon the amount of dirt still adhering depends the tare that will be recorded against the beet. Here is a constant source of friction between the factory and the beet growers, especially those who lack experience in harvesting beets.

There is opportunity for economy in harvesting beets. An inexperienced workman can readily lose the farmer considerable by the method of doing the work. In topping, for instance, no more of the beet should be removed than is absolutely necessary to get rid of the leaves and that part of the beet near the top containing a high percentage of impurities. A beet topper will soon familiarize himself with the requirements of this work. His eyes immediately select the place where cleavage should be made. With some beets it is necessary to remove more than with others. To remove more than is necessary is absolute loss. I have stood in beet fields and watched inexperienced toppers whose bad work in clipping off too much must have lost the farmer at least one-fifth of his crop. Again, there are more impurities proportionately near the crown than in other parts. If too much of this part is allowed to remain the purity coefficient is lowered as a whole. In some cases farmers are paid on a sliding scale according to the purity and sugar contents of the beets. From each wagon-load or carload a basket of beets is taken as a sample. From this basket a sample is taken for the chemical laboratory of the sugar factory. From this sample the amount of sugar in the beets is ascertained. The farmer is given credit for the sugar content of his whole load, according to the results of this test. If beets improperly topped happen to fall into this sample it is evident that the test will lower the total amount of sugar for which the farmer is paid.

Delivery of beets to the factory is one of the expensive parts of the farmer's operations. The cost varies considerably, according to the distance from the factory, the condition of the roads, and the farmer's facilities for doing the work. While beets are sometimes delivered by wagons for a distance of 10 miles it is not considered advisable to undertake their delivery over a maximum distance of 6 or 7 miles. If they are delivered by railroad much will depend on the freight rate. I have known beets to be hauled as far as 200 miles. As a rule, the greatest distance for railroad shipment should not exceed 75 miles.

It will be apparent that good roads are a supreme necessity in beet-growing districts. I find that beet growing is a great incentive for the betterment of roads. A farmer generally aims to deliver from 2 to 4

tons of beets at a load. He is working under favorable conditions when he can deliver two loads per day. Broad-tired wagons are an advantage. Proper grading and drainage of the roads are of the highest importance. There is a vast difference in the means used to facilitate delivering beets; with experience there seems to be a general tendency toward better facilities.

In delivering beets one farmer throws the beets into the wagon by hand and haul two-horse loads. At the factory he takes an ordinary shovel or beet fork and throw them into the bins. Another farmer uses four horses and employs some labor-saving methods for unloading the beets. For instance, he may spread out nets in the bottom of his wagon box and over its sides in such a way that he can lift with a hoist one-fourth, one-third, or one-half of his load. A crane is used to swing these nets full of beets over the bin, so that the load can be removed very quickly. At some of the factories arrangements are made for dumping a wagonload of beets automatically, the operation only requiring a minute or two. Some factories even have automatic dumps for unloading cars in like manner. Some factories have what are known as country dumps in close proximity to the beet fields. The farmers of a particular district can go to a dump of this kind, which is built on a siding or switch out in the country, drive up an incline until they reach a platform over the car, and, by use of an automatic dump, drop the whole wagonload into the car at once. Arrangements of this kind greatly facilitate the delivery of beets by the farmers and also very much extend the beet-growing area of the sugar factory.

It can be seen readily that the cost of harvesting a crop of sugar beets is one of the chief items of expense. Every possible economy in this work is therefore advisable. The adoption of labor-saving devices and methods depends mainly on the factory. It must provide the automatic dumps both at the factory and along the railroads throughout the beet-growing districts. Every factory can also exert considerable influence on the general character and improvement of roads. So important is the item of harvesting in the cost of producing beets that it is constantly receiving consideration by beet growers' associations and writers on agricultural subjects.

The factories are increasing the shed capacity, so as to accommodate larger deliveries of beets at a time. They are providing better facilities for unloading, so as to accommodate more teams. Sometimes those delivering beets are compelled to wait in a long line their turn at the factory. This consumes time and increases the expense of the farmers. The factories are building more automatic dumps, saving the farmer considerable distance in hauling and obviating congestion at the factory.



The time to deliver beets to a factory is one of the old questions involving more or less controversy between the growers and the factory people. The farmer naturally desires to harvest his beets as soon as they are ready, and deliver them to the factory, thus getting them out of his way, and eliminating further danger of loss. He also wants his money for his crop. The latter, on the other hand, has to consider the expense of building beet sheds on an extensive scale. Many factories adopt, without restriction, the policy of receiving all beets when harvested. If the storage sheds become full, the beets are simply dumped upon the ground near the regular sheds. I have seen as high as 20,000 tons of beets dumped in this manner after permanent frost weather had commenced. In the colder districts, like northern Michigan, Wisconsin, and Minnesota, it is hardly possible to construct sheds which will prevent the freezing of beets. After freezing weather starts, it is apt to continue uniformly cold, thus keeping the beets frozen. Storing beets outside would probably be more successful under such climatic conditions than farther south, where freezing and thawing are likely to occur. I believe it is the general desire and policy of all factories to arrange as fast as possible for a constant and general delivery of beets. There is no doubt that this does much to encourage the production of beets, and plenty of beets is the important problem confronting the factory managements. A sufficient supply of beets is the main thing upon which success depends. I am pleased to note that after a factory's first year there is a constant tendency to the satisfactory adjustment of all matters leading to controversy between the factory and farmer. The grower gradually learns to appreciate the difficulties besetting the factory, and the factory is constantly aware that its own acts are important in their effect on the farmer. From the very necessities of the case the management learns to be liberal in the matter of tare and in furnishing the facilities for saving time and expense in producing and delivering the crop.

#### USE OF THE TOPS AND LEAVES.

With the inexperienced grower, the best use to make of the tops and leaves of the beets is a question. The tops and crowns of the beets contain considerable quantities of fertilizing elements in available form. It is considered good practice by the best farmers to plow these tops under again, and allow them to decay and add humus and fertility to the soil. Many soils are especially lacking in humus. The disposal of this by-product sometimes develops a difference of opinion and interest between the owner of the land and the renter. The latter is likely to feel that it is not his duty to build up or maintain the fertility of the land. He naturally feels that the beet tops and leaves belong to him, and he wants to store them for feeding to his stock. They form a very succulent, nutritious, and desirable animal food. They are



easily grown and stored. I have also found that, even in cases where the owner of the land is growing his own beets, he deems it preferable to feed this refuse and supply the land with humus and plant food in some other way. For feeding, these tops and leaves are not always stored. In many cases as soon as the crop of beets is harvested, the stock is turned in on them and allowed to forage until they are consumed. A notable case where the preference is given to feeding this refuse rather than to fertilizing the fields is that of the American Beet Sugar Company at Oxnard. This company makes a careful study of everything pertaining to the whole question of sugar production. It owns a large farm and maintains a large herd of cattle, to which it feeds the beet pulp from its sugar factory. After harvest, stock is turned into the beet fields and allowed to consume the tops and leaves.

The owner of the land will have to determine for himself which is the more profitable of the two methods. He must certainly bear in mind that, to keep up the condition and fertility of his land, the tops and leaves must be plowed under or something else substituted. If his beets are grown by tenants and he desires to retain them on the land for fertilizing purposes, an arrangement to that effect should be made. Such arrangements are often made.

#### ACTUAL AND POSSIBLE YIELDS OF BEETS.

The vitality of the seed is an important factor in securing a stand of beets. If the rows are 18 inches apart and the beets in the row 8 inches apart, an acre will have 139 rows with 311 beets in each row. This gives us 43,329 plants to the acre. If the average weight of beets at maturity is 2 pounds, the product of the acre will be 86,658 pounds of beets, or 43.3 short tons. This presupposes a perfect stand, and that is what the farmer should strive for. Sometimes beets are planted farther apart, but 18 inches between rows is the usual rule in good fertile soil. The farther apart the rows the less the cost of cultivation, the larger the beets, and, as a rule, the lower the quality. If the farmer uses bad judgment in preparing his seed bed, or in selecting his time of planting, or plants seed of low vitality, he has injuriously affected his stand of beets. The average yield per acre of this country in 1904 was 10.47 tons—in round numbers, only one-fourth of an ideal yield. While it would hardly be fair to attribute the entire difference to defective stands, there is no doubt that much of it is due to this cause.

The assumption of 2 pounds as the ideal weight of beets is warranted by actual experience in growing beets. Often beets weighing 5 or 6 pounds are used in a factory. In some districts they are more often over 2 pounds than under. I believe the time is coming in the history of beet production when the farmers will be able to mature at least half of an ideal stand of 2-pound beets. Conservative con-

sideration must bring us all to the same conclusion. This gives an average production of 21.65 tons per acre, worth at present prices, \$108.25. If this can be realized, all competitors of the American beet grower will be distanced. Falling prices of sugar on our markets will be met by the increased profits resulting from better yields. The farmer will be able to take less for his beets, thus lowering the cost of sugar production.

There can never be a detrimental factory control over the farmer's product. The factory can not run without sugar beets. These are always in competition with other crops. In the natural order of things the farmer will produce those things on his farm which pay him best. The moment beets get below the competing point he naturally turns to other kinds of farming. On the other hand, the farmer is interested in the success of the factory, and he must realize that no concern of this kind can run for any length of time except upon a paying basis. While the factory management can do something to lower the cost of sugar production by improvement in methods, the greatest opportunity is that which the farmer has to lower cost of production by increasing his tonnage of beets.

#### FERTILIZATION OF BEET FIELDS.

As a rule our farmers growing beets are not as well advised concerning the problems of plant nutrition as European growers. In Europe, where beets are grown upon high-priced lands, necessity demands a more intimate acquaintance with the soil and methods of replenishing its supply of plant food.

The fact that a plant must be fed and nurtured in order to have it grow is information that is just dawning on the American farmer. As he grazed his stock formerly by allowing them to hustle for themselves, so has he been planting his crops and allowing them to subsist on whatever nature may have provided in the soil.

We grow beets on land worth from \$30 to \$300 per acre. In Europe they grow them on land worth from \$300 to \$1,000 per acre. As a rule, our beets are grown without any artificial application of plant food. In Europe particular attention is given to this feature and the growers produce from 50 to 75 per cent more on the average per acre than we do. It is generally conceded that our lands are naturally richer in plant food and that this condition will exist for some time to come. If we should give the same attention to fertilization, there is every reason to believe that our tonnage of beets per acre would exceed theirs.

In growing sugar beets there are a few principles of plant nutrition that must be kept in mind. Some soils may be abundantly supplied with particular elements necessary to plant life and deficient in others. Each particular kind of soil must be supplied with nutrition according to its needs. A soil may have an ample and balanced supply of

all but one of the necessary elements for promoting plant life and yet on account of that deficiency be practically a poor soil.

Beginning with the plant's germination and considering those things classified as plant food the first and probably the one of most importance is water. Water is necessary in the structural growth of the plant and it is the largest constituent element of most plants. It is the medium of outside contact between the plant and the food elements as they exist in the soil. It takes them up and holds them in solution and presents them to the receiving orifices of the rootlets for circulation and assimilation in the plant.

Dr. Harvey Wiley, Chief of the Bureau of Chemistry, U. S. Department of Agriculture, delivered an address before the American Beet-Sugar Association, held at Washington, D. C., April 12, 1904. A large part of this address was devoted to the plant-food requirements of sugar beets. I think it is one of the most instructive and practical discussions in print on this subject. It is designed to meet our own conditions and the comprehension of the popular reader. I shall review briefly some of the points he made and quote some portions of his address.

Carbon dioxid is one of the properties generally abundant in the air and soil surrounding the beet and in the water entering its circulation. It is one of the chief elements of plant structure, it being estimated that 90 per cent is made up of water and carbon dioxid. These make up 93 to 94 per cent of the total weight of the beet. When it is considered that sugar is purely a carbon compound, we may appreciate the importance of carbon dioxid as an element of plant food for sugar beets. This usually exists in abundance where beets are grown in arid districts, as well as in those where they are grown by rainfall.

Regarding the mineral ingredients of plant foods, Doctor Wiley says:

If you do away with mineral ingredients of foods you will do away with foods, because the moment you extract from foods the mineral substances you render digestion and assimilation impossible, whether of a plant or of an animal. The movement of juices and plants takes place almost solely by what is known as osmotic pressure. That can not take place in the absence of mineral substances. Hence the minerals in plant foods have a distinct physiological function aside from their incorporation into the tissues of the plants themselves.

There are only 2 pounds of phosphoric acid taken from the soil by a ton of beets, whereas there are 8 pounds of potash; but yet it is just as important that the beets should be fed liberally on phosphoric acid as that they should have a supply of potash. Phosphoric acid is especially valuable in the early stages of the plant growth. The beet is a plant that will take care of itself if you will bring it through its childhood. It is like our "infant industries," it needs protection, especially in the early stages of its existence. When the beet once gets hold, it is amply able to take care of itself. Therefore the primary principle of the fertilization of the beet is to do something to feed, nourish, and strengthen the young plant. It will usually find enough in the soil when its root system and leaf system have developed. The leaf system covers the soil above the beet, protects it from the rays of the sun, and conserves the moisture; and the roots reach out in all directions for nourishment. Phosphoric acid is especially essential in the early stages of its growth, but it must be in soluble form. If you



put phosphoric acid upon beets in the form of ground bone it will do no good. Even if you use a very finely ground soft phosphate rock, which may be decomposed in time in a natural way, it does no good in time to be of any benefit to the young plant at its basic stage when it is most useful. You want to feed the young plant soluble phosphoric acid; that is, phosphates that have been dissolved in sulphuric acid. You want to feed the plant liberally with this, especially when it is young. It may be well to feed the plant two kinds of phosphoric acid, one in a state of solution and one which dissolves later on in the season; but the one which is in a state of solution at once is the one which you should especially give. I do not care much how rich your field is in phosphoric acid naturally you should give it as much as 25 pounds of soluble phosphoric acid per acre and give it just before the time of planting, so that the young plant may have it at hand to draw upon.

It should be applied in the form of acid or superphosphates, which usually have from 10 to 16 per cent of phosphoric acid soluble in water and an additional amount soluble in citrate of ammonia.

Phosphoric acid is very cheap. I do not care how rich your soil is this will give strength to the young plant and help to tide it over the period of weakness through which it has to pass and over many vicissitudes, including the violent twisting and wrenching which are necessary to reduce it to a single plant at the time of thinning. All of these things are hard to resist, and therefore the young plant should have as much of its nourishment at hand as possible.

Another necessary plant food is nitrogen. After the beet begins growing if there is any nitrogen within reach it will take it, and you do not then need to have any care about later supplies of nitrogen, as you want phosphoric acid when the plant is young. Plants only eat nitrogen in the form of nitric acid. You may give them an abundant supply of dried blood or tankage or cotton-seed meal, which are splendid nitrogenous fertilizers, but they do the *young* plant no good at all, because before they can be assimilated by the plant they must be nitrified and that takes two, three, four, five, or six weeks before they are in the form for the plant to eat. Hence that form of fertilizer, although splendid for the future growth of the beet, is of no value to it at all at the time when it needs nitrogen most. Hence another thing which you should give your fields, no matter how rich they are, is a supply of available nitrogen, and the cheapest form of it is nitrate of soda.

I was just going to speak of the quantity per acre. Nitrate of soda is not only absolutely essential for beet culture, but it should be used with the greatest care, because it can do a beet crop an injury if it is injudiciously employed. Hence you must treat your plant in a systematic and sensible way. You want to give it a small quantity of nitrate of soda before planting the seed, incorporating into the soil perhaps one-half of all you want your young plant to have. After it comes up, in ten days or two weeks, apply the other half as a top dressing and stir it in. I should say that 100 pounds per acre would be ample for the needs of your plant, of which 50 pounds should be put into the soil at the time the seed bed is prepared and 50 pounds later on.

Nitrate of soda is extremely soluble in water and the soil has no affinity at all to hold it back. If you mix in a test tube a few grains of nitrate of soda with the soil and pour enough water on it to wash through once you take every trace of that nitrate of soda out of that soil. If you mix potash and phosphoric acid in there, you may wash it for a long time and still some of it will remain. So you see that it needs different treatment from other fertilizing materials; but your plant needs it; all plants must have it. The farmers of this country will never successfully grow beets to compete with the farmers of Europe with an average of 14 tons to the acre until they give their young plants what so many beet farmers do in Europe, a small quantity of nitric acid in a form immediately available for use.

If you should put that nitrate of soda on later in the season you might injure your beets, because it would stimulate them to a fresh growth when the beet should be ripening. Instead of getting the beets rich in sugar you would get a beet pithy and watery, perhaps of large size, but not suitable to manufacture. That is the reason that this element, which is so



essential in producing a beet crop, may be used in a way to injure it, and hence the reason why it must be judiciously employed.

Potash is especially valuable in sandy soils, because those are the soils in which it is deficient. In regard to the character of the soil for growing beets, I will say that it is a crop like Indian corn. It will grow on any kind of land where you will give it something to eat. There are some crops which prefer certain kinds of soil, as wheat, for instance. It is very difficult to grow a good crop of wheat on a sand bed. Wheat needs a clay soil; a heavy clay loam is the best. But beets will grow in a heavy clay if you will put enough lime with the clay to make the soil granular and friable. You have all seen fields that have been turned up by the plow in the spring where there were great clods which were difficult to break up even with a harrow. What does that mean? It means that the soil is deficient in lime. You need not analyze that soil to find it out. I will tell you every time if you will let me look at the kind of clods that are turned over at plowing time in the spring—provided they are not due to artificial tamping—whether or not that soil is deficient in lime. On clay that is so hard and impervious that you would think beets would not grow on it, if you will put on plenty of lime to flocculate it, you can grow a fine crop of beets. In sand, beets grow to perfection if you give them food.

I had a most remarkable experience about fifteen years ago. I was up in northern New York where they had a reclaimed swamp, and in that swamp they had grown a remarkably good crop of beets, not only a good tonnage, but beets which were rich in sugar. I was very much surprised at that, because I would not have thought that beets would grow to perfection on soil like that. Soon after that I was out in Indiana, on the Kankakee River, where the soil is made up of sand heaps and of low places filled with vegetable mold, and on one of those heaps of sand a farmer had grown a good crop of beets with a high content of sugar. Where could you get types of more divergent soils than those two? And yet both of them had grown good crops of beets, in quantity and quality. And so I say that the beet will grow on any kind of soil if you will prepare the soil for it. It will grow in pure sand if you will feed it enough.

Lime is one of the things most lacking in American farming land to-day. You can hardly detect a trace of carbonate of lime in some of our soils, and yet in order that the soil be properly fertile to produce the proper results it should always have a slight excess of lime in it, not because lime is such an essential constituent of the plant, but because of its effect upon other constituents of the soil and upon the nature of the soil itself. I have just told you that organic nitrogen, like dried blood, tankage, and cotton-seed meal, is a splendid nitrogenous fertilizer, but it must first be converted into nitric acid. Then the acid formed retards the development and the growth of bacteria. The moment these organisms begin to convert cotton-seed meal into nitric acid they begin to make the soil acid and tend to hinder their own work and will stop it altogether in a short time unless there is something there to take charge of that acid. There is nothing so good for that as lime. Wherever there is plenty of lime to combine with this nitric acid and form nitrate of lime, nitrification will go on with the greatest vigor and the plants will have an abundant supply of nitrogen in their food; but the very moment that lime is deficient then nitrification goes on with diminished speed and finally stops altogether. That is one of the essential reasons for the usefulness of lime.

You may wonder why the lands in England that have been under cultivation for so many hundreds of years are still fertile; and you wonder why they do not grow acid, and why the bacterial organisms do not cease to work. The reason is that a great part of England is chalk. At the grounds of the great agricultural station in England, you can pick up lumps of chalk all through the soil, and if you pour a little acid on that soil it effervesces like water from a soda fountain. Now there is a soil which you can manure with barnyard manure for an indefinite time and still you will never make it acid, and still you will have nitrification going on with vigor.

I say that our farmers must learn to use lime. The beet farmers have an excess of lime in the refuse of their factories. Thousands of tons of lime cake are thrown out every year, every pound of which is especially valuable and should be carefully preserved and placed on

the fields; and if that is not enough they should buy lime, if necessary, if they have not got limestone on their own land. It is not necessary for it to be burned, except that that is the most convenient way of reducing it to a powder; but ground limestone or ground chalk is just as efficacious. Our people are only now awakening to the fact that they must have lime, and have it in abundance.

I have not said much about applying potash artificially, because soils usually have plenty of potash in them for all immediate wants; but we must look forward to the time when even potash will begin to disappear, especially if we have sandy soil. We can not expect large yields from soils of that kind without a liberal supply of potash.

This discussion anticipates that it is the purpose of the reader to grow sugar beets. While I think it is pertinent and applicable to the production of any crops, I am especially instructing sugar-beet growers. In producing this crop responsibilities are greater, expenses are higher, general results are on a more extensive scale, and larger profits are to be anticipated. For this reason the farmer is presumed before entering the business to be prepared to do those things that will accomplish satisfactory results. If not, he should stick to things in cropping not so hazardous, expensive, or complicated.

It is within the province of every farmer to have his soils analyzed chemically and mechanically to determine their constituents, so that he will know which elements of plant food are there in abundance and which are deficient. With such a bill of particulars before him and with the recommendation of the soil physicist and the chemist he is enabled to intelligently nourish his ground for best results in sugar-beet production. Of course this involves expense. To bring the best results the farmer should utilize those things that make his farm most productive. It is just as necessary for him to be advised and to know where he stands as it is for the merchant or manufacturer. After determining the needs of his farm, he should proceed to supply them through the best agencies at hand.

Like many other good things, fertilizers, through lack of proper information, often become a detriment instead of a benefit. The farmer often sees great returns coming from a piece of land through the use of certain fertilizers. He naturally concludes that these are exactly what his farm needs, and proceeds to give it the same treatment, to its detriment and to his loss financially. This is why we find such a diversity of opinion in farmers' institutes and in discussions through the agricultural press in regard to the use of certain fertilizers. Dealers in fertilizers are like dealers in patent medicines; their advertisements indicate a cure for every evil. It is just as necessary that fertilizers should be used for specific purposes as that medicine should be so used.

Where mineral plant foods are lacking, they must as a rule be procured from the markets in some form or other. But aside from commercial fertilizers, we must not overlook two very important sources of fertility within the reach of every farmer and generally adapted to

all farms. I refer to barnyard manure and green manures. While barnyard manure is very useful it is possible to apply this in a way that is actually harmful. One of the objects of using barnyard manure is to increase the humus in the soil. For this purpose the manure should be well rotted before its application, or it should be applied long enough before cropping to become thoroughly rotted and distributed in the soil. I presume it is in the experience of every farmer that if it is applied in the spring just before the ground is plowed without time for these changes to take place the soil often dries out quicker and is less capable of resisting the drought than otherwise. In growing sugar beets it has usually been found essential to apply manure the summer before fall plowing for beets; or, better still, to grow one crop and then follow with beets. Too much can not be said in favor of this old-fashioned fertilizer. It should be the policy of the farmer to so balance his stock and crop interests as to have enough stock to consume everything grown upon the farm. In this way he establishes a sort of perpetuity in soil fertility. He produces and feeds crops and the residue is carried back in the form of manure for the replenishment of his land. Such farming forms an endless chain, fraught with increasing productiveness and benefits.

Continuous growth of a single crop is detrimental to the land's productive power. Rotation should as a matter of fact be regarded as a feature of fertilization. No matter how well land is replenished with fertilizers or how well cultivated, it still lacks a very necessary feature of plant growth, and that is rest. A change from one kind of crop to another seems in most places to furnish this rest. I quote again from Doctor Wiley's address:

I do not care how <sup>good</sup> your soil is it will not be many years before you will find that it will refuse to grow a crop of beets if they are planted every year, even if you should supply plant foods which the crop takes off, because the soil is, as I have described it, a living organism. It is as much alive as an animal or a plant; and as an animal is benefited by a change of pasture and a plant is benefited by a change of locality, so the soil is benefited by a change of crops. It demands change and recreation just as much as a plant or an animal does.

There are certain kinds of crops which are best adapted to the application of fertilizer, especially barnyard manure. Rotation offers the opportunity for building the land up in the proper way at the proper time. It furnishes rest through change. The insertion of legumes in the rotation at the proper periods for replenishing the nitrogen is an important feature in crop rotation.

The principal leguminous crops are clovers, alfalfa, peas, and beans. Any green crop plowed under at the proper time benefits the soil, but it has generally been found preferable to use the legumes for this purpose.

It is not considered necessary or advisable to enter here upon an exhaustive discussion concerning the use of manures and fertilizers



for the improvement of soils. The Department of Agriculture has issued in large editions for free distribution to all applicants the following Farmers' Bulletins which will prove useful to those who wish fuller information on this subject: No. 44, Commercial Fertilizers; No. 192, Barnyard Manure; No. 245, Renovation of Worn-out Soils.

#### IRRIGATION.

Irrigation is becoming one of the most prominent factors in the agricultural development of this country. Settlement and development were originally confined to land moistened by rainfall. The great area of country west of the 100th meridian has assumed a constantly increasing importance for nearly a half century. First, it was looked upon as a desert; next, it was recognized as a great plain, sparsely provided with vegetation, supporting roving bands of buffalo, deer, antelope, and their enemy, the Indian. Then it became useful for grazing, each animal being allotted a large portion of land. Finally, irrigation was introduced in a small way for the production of grains, tame hay, and other feeds for stock. Irrigation has increased until it has become the dominating force in the agriculture of the West. Strike out the canals and ditches carrying water to the land and all the agricultural development and prosperity would vanish like a mirage or like the ancient civilization of Egypt and some other desert countries, the remains of whose canals and irrigating ditches are found by modern archæological explorers.

Sugar beets have proven very resourceful in irrigation farming. In some places beets are grown entirely by irrigation. In some localities this is true in some years and only partially true in others. Certain districts regularly count on rain for the early part of the beet's growth—say to the middle of the growing season—after which irrigation is necessary. In some other localities it is necessary, as a rule, to “irrigate the beets up” and give them a start, the rainfall coming to their aid later in the season. In still other localities sufficient rain falls to grow a good crop of beets some seasons, while in other seasons full irrigation is necessary.

There can be as much damage done by overirrigation as by lack of it. There is a general tendency to irrigate too heavily. In the artificial application of water the necessity for intelligent action on the part of farmers is very important. Water can be administered too often or not often enough, in too great quantities or in too small quantities, or it may be administered at the wrong time. To avoid these mistakes requires careful study and close observation. There appears to be a greater tendency to water beets too much than too little; to water them too often than too seldom. Nothing but intelligence and experience can evolve any safe rule of action.



It is an accepted rule among practical growers that beets should not be irrigated unless they absolutely demand it, as shown by their failure to recuperate after a hot day's sunshine. As long as they recover, the water should be kept off. When they fail to do so, it is evident they are needing moisture, and irrigation should follow. Sometimes after a dry spell the ground is thoroughly soaked by irrigation, and this is suddenly followed by a rainy spell, which, with previous irrigation, oversaturates the soil. Overirrigation is especially damaging in the early stages of the beet's growth. The beet should send down its rootlets and thoroughly intrench itself in the soil. If forced to seek its moisture, it will show a pronounced tendency to do this. If we apply too much moisture to the land while the beet is young, this process is arrested. The beet will depend too much upon the artificial supply and fail to send its roots down and out to provide it with sustenance. When such a beet matures, it is short, ill formed, and unsatisfactory for sugar-making purposes.

After a beet has reached the period of ripening, overirrigation is again very deleterious. It causes the beet to start new growth and send out new laterals and rootlets. This causes a lowering of the sugar content and purity of the beet, and some time is required for recovery.

#### CLIMATIC CONDITIONS AND FARM AND FACTORY RESULTS FOR 1905.

##### CALIFORNIA.

The first factory successfully operated in this country was established at Alvarado in 1879. A large sugar factory is still operated at that place. There is probably very little or none of the original machinery in use. If not worn-out, the gradual improvement in machinery would have made necessary its replacement long before this.

While California is generally classed among the semiarid States, beet production was originally carried on there without irrigation. While facilities for irrigation have been considerably developed, and the U. S. Reclamation Service is at present building large irrigation works, the State nevertheless has valleys which regularly produce bountiful crops by rainfall only. One of the crops which has proven successful in these valleys is sugar beets. The area which has been tested in sugar-beet growing embraces the valleys on the coast side of the mountain ranges from Los Angeles northward to San Francisco. Much has been accomplished in supplementing the rainfall by the development of irrigation through the establishment of surface ditches heading in the streams of the foothills and mountains and through artesian wells and pumping stations. It is generally considered that enough water will fall during the rainy season to grow sugar beets. In

the districts where factories are already established, and where irrigation facilities exist, irrigation water is required only to supplement the rainfall. There was a period beginning with 1898 and lasting for three or four years in which the rainfall was very much below normal, as shown by the State's record. Sugar beets, along with other things, suffered on this account. While temporarily inconveniencing beet growers and causing considerable loss, this period of drought led to the establishment of irrigation facilities in many parts of the State, and therefore proved of incalculable permanent benefit. During the season of 1904 abundance of rain fell throughout the State, and good crops were produced. These rains come during the months of January and February. During these months in 1905 the amount of rainfall in southern California was from 10 to 12 inches. As a rule the rains were slow and soaking. The soil is of such nature that water is readily absorbed and held until utilized by the growing crops. Following the rainy season the weather in early spring was quite favorable to beet production. This gave an opportunity to make early planting and secure a good stand and gave the beets a chance to send their roots down and out before dry conditions set in. This is what the beet producers in California desire. The same conditions have been repeated in the early part of the winter of 1906. Up to this date (March 1, 1906) about 11 inches of rain has fallen. Indications point to a prosperous year in beet farming for the campaign of 1906. Crop producers of the State generally look with favor upon the fogs that are more or less prevalent during the growing season. They tend to retard the evaporation of moisture already in the soil.

ALVARADO.—Surrounding Alvarado are hundreds of acres of rich bottom lands made annually prolific in years past by the overflow from the Alameda Creek, which runs through the town. These lands are largely devoted to fruit and vegetable growing. Sugar beets do well here.

Climatic conditions in this section during the season were not uniformly favorable. The quantity of beets produced was not sufficient to maintain a factory through a normal campaign. The sugar contents and purity, however, were considerably above the normal. This has a tendency to compensate for lighter yields and a smaller supply of beets.

CROCKETT.—This plant has been idle for some time. With the beginning of the season indications pointed to its reopening. It has a capacity of 1,200 tons of beets daily. It is designed for refining as well as for manufacturing sugar. Formerly it manufactured sugar during the beet-sugar campaign and refined Hawaiian sugar during the entire year. It is reported that about 3,500 acres were planted to beets, but the beets were so badly injured by blight that not enough

matured to justify the planting. Something like 500 tons were harvested and shipped to another factory.

LOS ALAMITOS.—In this district the early season of 1905 was quite favorable. Up to February 4 about  $8\frac{1}{2}$  inches of rain fell. Over 2 inches of this occurred in one precipitation. This had a tendency to insure the beet plantings, which occur from the 1st of February to the early part of March. This district is gradually bringing its beet area under irrigation through a system of artesian wells, some of them flowing and others requiring the use of pumps.

The farmers in this vicinity are learning to use the refuse lime from the factory on their land, as it is deficient in this element. A large amount of stock is fed around this factory upon its pulp product and beet leaves and tops from the fields.

This district produces alfalfa to a considerable extent. Waste molasses from the factory is disposed of by mixing it with the hay, usually when it is stacked.

There has been a remarkable tendency to develop stock feeding in this district, pulp being regarded quite favorably as an element in the ration with alfalfa and other things grown there.

The factory uses California oil for fuel. The campaign begins early at this place, generally in the early part of July, but it was retarded this year on account of the prevalence of cold weather. Several hundred acres of beets were affected by attacks of worms.

The sugar contents and purity of beets grown in this district are generally very high. This year the sugar contents ranged from 16 to 23 per cent and the coefficients of purity averaged 80. Delivery of beets began August 3 and slicing at the factory August 5. I clip from the Anaheim Gazette, a paper published in this district, the following:

Prosperity is spelled with a large P this year among the growers. As an instance of what may be done with two 6-horse teams and a hired man for three months, George Arthur Garner has a stand of 177 acres of beets from which he will harvest 10 tons per acre. At the usual average of \$5 per ton his share of the crop (three-fourths) will bring him \$6,637.50. Against this, expenses are charged of \$1,896.23, which includes feed for horses, seed, and labor, all but \$300 of which was supplied by the sugar company under the usual provisions of the contract. Hence he has been doing business on the company's capital.

After deducting harvest expenses he estimates he will have a net return of about \$3,600. It is needless to say he is well satisfied and will continue raising beets. He says: "Get a good early start and the work can be handled easily."

Many farmers have already signed up for their next season's acreage and secured their contracts.

An unusually heavy fall of rain occurred at the latter end of the harvest, 2.69 inches falling in one storm. It is claimed that some beets tested as high as 29 per cent of sugar with an average of 19 and a purity of 82. The factory contract price for next year is announced as \$4.50 per ton, with 30 cents additional for each 1 per cent above 12, and 25 cents deduction for beets showing 11 per cent or lower.

SALINAS.—This factory, located in the Salinas Valley, not far distant from San Francisco, has a capacity of 3,000 tons of beets daily. I



believe, however, as a rule the factory runs considerably below this capacity, as the district has never been able to furnish it sufficient beets to run at full capacity. Weather conditions in the early part of the year were favorable for beet plantings, and fields as a rule showed very good stands. Indications in early April were probably as favorable as at the same time in any other season since its beginning. Deliveries of beets began September 11 and slicing September 19.

**BETTERAVIA.**—This concern, with a capacity of 500 tons daily, began the year of 1905 under most auspicious circumstances. It had a campaign of about one hundred and sixty days. It opened early, working first on refining brown sugar left over. Deliveries of this season's beets began June 12 and slicing June 17. About 7,000 acres were planted to beets, most of these being grown under irrigation. Conditions were favorable to a long campaign. Beets in the district can be planted from the 1st of December to the 1st of April.

**CHINO.**—This is the first plant established in California by the American Beet Sugar Company. Early in the season climatic conditions were quite favorable. Indications pointed to better results than for several years. A good stand was secured. The crop started off with more than the usual moisture in the soil and indications of a good yield. Later the weather was a little cool for beets, which delayed the harvesting. The campaign began August 21 and closed November 1.

The American Beet Sugar Company has announced the terms under which it will contract to buy beets from growers during the season of 1906. Under the new contract the company will pay a higher price for beets than it has hitherto paid. Under the present contract the farmer received \$4.25 per ton for beets averaging 15 per cent of sugar, with an additional 25 cents per ton for each 1 per cent over 15, and a corresponding reduction in case the sugar content fell below that percentage. Under the new contract \$3.50 per ton will be paid for beets testing 11 per cent of sugar and 25 cents per ton for each additional per cent over that up to 15 per cent, and 30 cents for each additional per cent above 15. Judging from the average sugar content, as shown by last year's record, this will mean an average increase of 35 cents per ton for beets, and the company pays the freight. This should result in a largely increased acreage.

**OXNARD.**—At this place is located one of the most important sugar plants in California. It probably averages a larger daily output of sugar than any other plant of the kind in the country. The concern owns considerable land, which it endeavors to handle according to the latest approved methods of farming. It annually feeds a large number of cattle. To its herd are fed large quantities of pulp produced by the factory and the beet tops from the beet fields. On its own land it



conducts experiments for soil improvement through drainage and fertilization. It is one of the most up-to-date concerns of its kind in the country, and its success tends to promote the general interests of the beet-sugar industry. The season started out with abundant rains. Its contracts early in the year aggregated 15,000 acres. It is the aim in this district to have the beet crop planted by the 1st of March. Consequently its sugar campaign begins early. The season continued favorable throughout the growth of the beets, resulting in a crop of more than usual importance. Beet delivery began at the factory July 11, and the factory began slicing July 17. It is estimated that about 13,000 acres were harvested. The season throughout was quite favorable, the beets running high in sugar and purity and continuing good to the last.

#### COLORADO.

This State holds a unique position in the history of development of the beet-sugar industry. It entered the field at a comparatively recent date, but already 12 large plants have been installed. Their locations and daily capacities for working beets are as follows:

	Tons.		Tons.
Rocky Ford .....	1,000	Loveland .....	1,200
Lamar .....	400	New Windsor .....	600
Holly .....	600	Longmont .....	1,200
Sugar City .....	500	Fort Collins .....	1,200
Eaton .....	600	Sterling .....	600
Greeley .....	800	Grand Junction .....	500

Three other factories are now being constructed in the State—one located at Brush and one at Fort Morgan, each with 600 tons capacity, and another at Swink, with a capacity of 1,200 tons. These will give the State 15 factories. It is quite probable that two or three more will be built during 1906 for the campaign beginning in the fall of 1907. Seven factories, namely, those at Eaton, Greeley, Loveland, New Windsor, Longmont, Fort Collins, and Sterling are associated together under the management of The Great Western Sugar Company, with headquarters at Denver. Those building at Brush and Fort Morgan, Colo., will be associated under the same management. The factories at Rocky Ford and Lamar are under the American Beet Sugar Company, having western headquarters at Denver.

The first factory was installed at Grand Junction in 1899, and all the others since that time. The fifteen factories have an aggregate daily capacity for working 11,600 tons of beets, and an approximate daily capacity for producing 1,276 tons of sugar. Assuming the average campaign to be 100 days, the State's production with its present capacity would be 127,600 tons of sugar annually. Valuing this sugar at \$100 per ton, this annual product represents \$12,760,000.

The agricultural interests of the State generally are progressing as rapidly as the sugar industry. This industry has stimulated all sorts of improvements. Stock feeding is developing with every indication that this will be a prominent agricultural feature.

Prior to the advent of the sugar industry the State had been known principally for its mining interests. According to the latest records its production of the precious metals in 1905 was as follows: Gold valued at \$25,535,057; silver, \$8,501,233; total, \$34,036,290. If the production of copper, lead, and zinc be added to this, the total is increased to \$45,257,522. These figures are taken from the official statements of the bullion received at the United States mints and returns made by smelting companies, as compiled and printed by the Denver Republican in its Annual, January 1, 1906.

In the issue of the Denver Post for December 31, 1905, is a résumé of the agricultural productions of Colorado for the year. The data, which were also gathered from official sources, are as follows:

*Farm and range products of Colorado for 1905.*

Hay.....	\$16, 000, 000
Sugar beets.....	7, 500, 000
Dairy products.....	10, 000, 000
Fruit.....	10, 400, 000
Potatoes.....	4, 000, 000
Wheat.....	4, 500, 000
Vegetables.....	2, 250, 000
Oats.....	3, 000, 000
Corn.....	1, 000, 000
Field peas.....	1, 500, 000
Barley.....	300, 000
Rye.....	30, 000
Total plant productions.....	\$60, 480, 000
Cattle.....	22, 000, 000
Milch cows.....	4, 314, 000
Sheep.....	8, 000, 000
Hogs.....	975, 000
Horses.....	11, 200, 000
Mules.....	3, 000, 000
Wool crop.....	2, 500, 000
Total animal products.....	51, 989, 000
Total products for 1905.....	112, 469, 000

According to these statistics the agriculture of Colorado is fast outstripping its mines as a source of wealth.

Success has attended the development of the beet-sugar industry in Colorado from the beginning. The beets are grown mostly by irrigation. Plants have been erected only in places having sufficient permanent and regular supplies of water.

The season of 1905, taken as a whole, was better than usual. The rainfall was ample for the preparation of the land and for the planting and germination of beet seed. A good stand was secured generally. The low price of other commodities produced on the farm coupled with the regularity of prices of beets induced more farmers to take up the beet culture. By the middle of April planting was in progress quite generally throughout the State. It is estimated that for the seven factories in the northern part of the State 60,000 acres were planted. Making all the usual allowances, the production of beets can safely be estimated at 630,000 tons, which will return to the farmers \$3,150,000. This amount of money will be distributed in seven localities only. The weather continued throughout the season more than usually favorable, and the production of beets may be fairly rated as normal. Rainfall has materially aided irrigation.

**ROCKY FORD.**—The American Beet Sugar Company operates a factory at this place of 1,000 tons daily capacity. It was the second installed in the State, and is one of the most successful in the United States. Beets are grown largely by irrigation supplied from the Arkansas River. The results of the work of this factory have been largely instrumental in stimulating interest in sugar production throughout the State. By producing its own beets, this company has built up sugar-beet production in its district to such an extent that it has been found necessary to install two other plants to use the supply, namely, those at Holly and Lamar.

The season, though quite unfavorable to many other crops, such as alfalfa, cantaloupes, and fruit, was not unfavorable for sugar beets. A good stand was secured and the crop continued as a rule to thrive. It appears probable that the factories in this district can continue to count on the cooperation of the farmers. The factory pays \$5 per ton for beets delivered by wagon or on board cars at the stations. Harvesting began September 25. The factory began operations October 2 and closed about February 15.

This factory lost by fire during the campaign about 5,500 tons of sugar, valued at \$465,000. This loss was occasioned by the burning of the sugar warehouse, the fire probably originating from defective electric-light wiring or spontaneous combustion.

**LAMAR.**—The American Beet Sugar Company moved a factory from Norfolk, Nebr., to this place and installed it during the past season, increasing its capacity to 400 tons of beets daily. Beets have been grown at Lamar to a considerable extent for the factory at Rocky Ford, about 60 miles farther west. Consequently beet culture was not a new thing to the farmers here. Contracts covering about 6,000 acres were secured. The planting of beets was finished early in May. In addition to beets grown for this factory, growers in this county also

furnished a supply to the Rocky Ford factory. Over 7,000 acres of beets were grown altogether. The early season was generally quite favorable. Water for irrigation was secured in abundance. Crop conditions were normal. The factory pays \$5 per ton for beets delivered by wagon or on board cars at the stations. The factory started September 25, first testing its machinery preparatory to regular operations. Harvesting began September 27. Factory operations began October 2. Three hundred men were employed in the factory. Beets were very satisfactory.

**HOLLY.**—A plant of 600 tons daily capacity was installed at this place during the season. It had contracts covering 6,000 acres of beets, and this area was planted. Its lands are irrigated from the Arkansas River. Spring rains were sufficient for the planting and germination of the beet crop, though the early season continued quite cold, which had a tendency to retard the growth of the plants. As a rule the stand was good and indications continued to point to a favorable beet-crop season. Some replantings were necessary on account of the wet spring. On the whole, results may be counted as favorable, and the first campaign of the factory more than usually successful.

**SUGAR CITY.**—A factory of 500 tons daily capacity is located at this place. It was the third to be installed in the State. The company owns about 12,000 acres of land. Its beet lands are watered through irrigation from the Arkansas River. It is especially fortunate in its water rights. It owns two lakes, known as the Twin Lakes, in the mountains near Leadville, about 200 miles distant. The water from these lakes is measured into the Arkansas River near them. The same amount of water is again measured to the factory out of the Arkansas River into its own ditches leading from the river to the factory lands. It owns a large storage lake, called Lake Henry, on a higher elevation than the beet lands; to this its main ditches lead. When this becomes full it has another smaller reservoir, known as Lake Meredith, near the factory, into which the waters are spilled and from the latter distributed to beet lands on the lower levels. In all these factories in the irrigation districts rainfall is generally preferable for planting and germination of beet seeds. In this district natural moisture was quite sufficient and the season opened very auspiciously. Five thousand acres were contracted for. Alfalfa is one of the principal crops here, and it is found quite desirable to have alfalfa precede beets. The middle of May practically all of the beet fields were bunched and thinned.

The season continued favorable throughout the growing period of the beets. Worms appeared to some extent, but no material damage resulted. From beginning to end the season was several weeks earlier than last year. Grasshoppers appeared in sufficient number



to do material damage to other products, but attacked sugar beets very little.

The factory installed an automatic country dump in one of its outlying beet-growing districts to expedite beet delivery and encourage further beet production. The season can be summed up as one of the most favorable experienced by the factory since its commencement. Its supply of beets was larger and the campaign longer. Beets were up to the average in sugar contents and purity. The tonnage was up to anticipation. The average content of sugar for the first week was 18 per cent. The general factory averages were 16 per cent sugar with a purity of 84. The company has a steam plow for breaking up the land. Considerable stock is fed around this factory, and the resulting barnyard manure placed on the land for fertilization. The factory stopped slicing beets December 24. The management contemplates doubling the capacity of the concern and installing the Steffens process.

EATON.—In the Eaton district conditions are quite similar to those at Greeley. Alfalfa, potatoes, and wheat have been the principal farm products. The beet growers of this district have been well accustomed to field cropping. Contracts for the season covered about 5,600 acres. The company pays \$5 per ton for beets.

GREELEY.—From the beginning work and conditions at this factory have been ideal. It is well established agriculturally. Where developed the district has been largely devoted to the production of potatoes, alfalfa, and wheat. These are well adapted to rotation with sugar beets. Some of the factories in Colorado have necessarily been established in districts where agricultural methods and resources have not been well developed, but Greeley is in one of the oldest and best developed districts in the State. It is estimated that the contracts for the factory's supply of beets covered about 8,000 acres. The company pays \$5 per ton for beets.

LOVELAND.—The factory located at this place is one of the largest in northern Colorado. It arranged contracts with farmers for 14,000 acres of beets for the campaign of 1905. The company operates a railroad of its own, east of Loveland, 20 miles long and fully equipped with rolling stock. This road is operated purely in the interest of sugar production. It traverses beet fields, conveys the raw materials as well as the finished products, and connects through its switching facilities with other roads. During the season a great many improvements were made at the factory proper. In the past the factory has experienced more or less trouble on account of congestion of beets at the delivery season. Often many thousands of tons were piled up on the ground in its yards. Storage bins of three-fourths its capacity were installed this season. In addition to this it put in a Steffens plant, to work on the waste molasses for a further

recovery of the sugar contained therein. It is estimated that about \$300,000 was expended on improvements. The tonnage of beets for the season was estimated at 150,000 tons. The campaign opened about October 1. The season continued quite favorable throughout the early part. Slicing began October 2. A considerable portion of the beets produced for this factory were turned over to the factories at Longmont and Fort Collins on account of exceedingly heavy growth in the Loveland district.

**NEW WINDSOR.**—The factory at this place enjoyed conditions quite similar to those described for Eaton and Greeley. It is also located in one of the old well-established farming districts where irrigation is well advanced and thoroughly understood. In fact it is located near Greeley and Eaton. Contracts were made for the growing of nearly 7,000 acres of beets for the campaign of 1905. The hand work of growing beets in this section—including Greeley, Eaton, and New Windsor—is done mainly by 1,500 foreign laborers, largely Russian and Japanese. Delivery of beets began September 23. The factory began slicing September 26. The campaign ran over 100 days.

**LONGMONT.**—The capacity of the factory at this place was increased prior to the campaign to 1,200 tons daily capacity. It contracted with the farmers for about 7,500 acres of beets. Along with the rest of the factories in northern Colorado it experienced a favorable season, considering everything. The agriculturist says the tonnage in most cases was satisfactory. The crop is not quite up to that of last year. With more late water the crop could have been increased. The sugar content of the beets was all right. The harvest began September 25, and slicing beets October 10.

**FORT COLLINS.**—The factory at this place also enjoys the advantage of being located in an old established farming district, which is also the home of the State agricultural college and experiment station, the mutual relation existing between the two being naturally quite beneficial. The station is conducting many experiments in beet growing and stock feeding with the by-products of the factory. This year contracts were secured for about 10,000 acres. The season started quite early and was on the whole favorable to beet planting.

An association known as the Fort Collins Beet Growers' Association, composed mostly of business men, planted about 1,000 acres of beets purely as a business enterprise. The sugar-storage capacity was increased to about 20,000 tons. The factory began slicing October 4. The crop was estimated at 120,000 tons of beets. About 500 men are employed. The estimated acreage planted was 10,003, an increase of 4,000 acres over 1904. The average tonnage was a fraction under 12 tons per acre, as against 13.2 tons the year before. That falling off was due to planting new lands. The highest tonnage was 25 per acre, the lowest 7.

STERLING.—The factory located at this place was one of the new ones beginning its first campaign this year. The district had been growing beets for three or four years quite extensively, most of them being disposed of to the factory at Eaton. About 7,500 acres were covered by the contracts for producing beets for the first campaign. This is one of the factories associated under the name of The Great Western Sugar Company. Its capacity for working beets is 600 tons daily. It is located on the Union Pacific Railroad. Lands are irrigated with water from the Platte River. The factory commenced slicing November 7.

GRAND JUNCTION.—The factory at this place was the first one installed in the State. Its original capacity was 350 tons, but during the season it was increased to 500 tons. The factory beet-growing area is located in one of the finest fruit-growing sections of the State. The management of this plant found it necessary to insure its annual supply of beets by having land of its own and devoting it to this purpose and the production of other crops in rotation. It now owns nearly 5,000 acres of land. It is in a position to command the situation in regard to its beet supply. At the beginning of the season it had under contract 5,500 acres of beets. This district enjoyed, with the rest of Colorado, generally favorable conditions. Estimates made August 1 placed the crop at 40,000 tons on an acreage of 4,000 planted. The factory began operations October 7, and stopped slicing December 20; it had a satisfactory run, but the beets were not up to expectations.

#### IDAHO.

Agriculturally Idaho has been considered one of the newest and least developed States in the Union, but during the year agricultural development has received a remarkable impetus. This was brought about largely by the installation of the sugar industry. Experiments had developed that the soil possessed rare qualities for producing sugar beets. Previous to this season three factories have been installed in the State, located as follows: One at Idaho Falls with 1,200 tons daily capacity, another of the same size at Sugar, and one at Blackfoot with 600 tons daily capacity. All of these are in the southeastern portions of the State. Water for irrigating the land comes from the Snake River. The building of two other factories has been contracted for—one to be in readiness for the campaign of 1906 and one for that of 1907. The first is located at Nampa and will have a daily capacity of 600 tons, and the second at Payette, with the same capacity. The three factories operating in the State this season are associated together under the name of Idaho Sugar Company, the main office being at Salt Lake City, Utah. The establishment of these great plants in a sparsely-settled, undeveloped section has done much to call attention to the general resources of the State and to promote



its development. The Snake River traverses the southern section of the State and up its western boundary to a considerable extent. Located along its course are many beautiful fertile valleys capable of high development agriculturally. Its crop resources are good generally. Root crops and deciduous fruits of many varieties grow well. All fruit and vegetable products grown in the State have generally been of a high quality. At the present time probably no other section in the United States is receiving as much attention as these districts of Idaho. Settlement is fostered mainly by the results of sugar production and the facilities afforded. Not alone along the Snake River but throughout the valleys in its interior to its northern boundary are many districts capable of developing a water supply and agricultural resources for production equal to those along this river. The establishment of these five large plants indicates a recognition of its resources by the capitalist and the home builder.

**IDAHO FALLS.**—A factory of 1,200 tons daily capacity has been in operation for two seasons past. The factory was able to secure the planting of 6,000 acres to beets. The rainfall was quite sufficient in the early season, and this was followed by further rains and cold weather. Finally the season settled down to good growing weather and continued quite favorable for beet production throughout the rest of the season. The factory started October 9. The estimated length of the campaign was one hundred days. Between 5,000 and 6,000 acres were harvested.

**SUGAR.**—Farmers went into beet production with more zest on account of experience with other crops. The difficulties of fruit growing and demoralization in prices of other products compared with the regularity of the beet crop under the same circumstances has had a tendency to elevate beet production throughout the district. Weather conditions started out quite favorable. The factory located at this place has a daily capacity of 1,200 tons. Two spurs were built during the season to extend railroad facilities through the beet-growing districts. Eight thousand acres under contract were planted to beets, thus insuring the factory a satisfactory supply. Among the improvements inaugurated in this factory was the installation of the Steffens process for recovering sugar from waste molasses. By May 10 most of the beets were planted and up. Weather conditions during the growing season were generally favorable to producing a good yield.

**BLACKFOOT.**—A factory of 600 tons daily capacity was installed at this place in time for the campaign of last year. The early season was quite favorable for beet planting. This was followed by cold wet weather which retarded germination. As the season developed, conditions became more settled and quite favorable to beet production and continued so throughout the growing season. Though the weather was favorable the water in Snake River became quite low,



reducing the supply of irrigation water and interfering to a considerable extent with the development of the crop. It was determined that water was being too freely used farther up the river, in fact, wasted. Through an order of the court this matter was adjusted, after which beet growers in the Blackfoot district secured a more ample supply of water. The factory began slicing October 9. On July 6, 1905, this factory became, through purchase, a part of the holdings of the Idaho Sugar Company.

#### ILLINOIS.

The State of Illinois has done much experimental work to test conditions for growing sugar beets. The investigations show that the State has conditions favorable to the establishing of the beet-sugar industry. It has great commercial centers, transportation facilities, and resources. The soil is productive of beets of the quality desired for factory use. Some years ago a factory was established at Pekin. It happened that the season during which this factory attempted to operate was quite unfavorable for the production of any crops, including of course sugar beets. There were differences of opinion among the management of this institution. It ran for one year, closed down, and was dismantled. The building and some parts of the machinery were used for another purpose. This resulted in the abandonment of beet-sugar production before it had had a fair trial in the State. This experience has had a discouraging influence on all subsequent attempts. There are many places throughout the State where investigations have developed favorable conditions. Beets have been grown to a considerable extent in the northern portion of Illinois for factories in Michigan. In the district east of Chicago, and south of Lake Michigan, about 1,200 acres were grown at one time for the plant at Kalamazoo, Mich. The yield and quality of the beets were good. Personally, I am convinced that there are many places in the State well adapted to beet-sugar production and that this fact will eventually be recognized. The advantages of manufacturing sugar in a district having the great commercial facilities possessed by northern Illinois can not long be overlooked. The advantages of Chicago as a distributing point for such a commodity, and the ramifications of railroads reaching the markets in every direction, along with the natural conditions favorable to beet production, will some day impress investors.

**RIVERDALE.**—During the past season Mr. Charles Pope, of Chicago, built and equipped a factory at Riverdale, a few miles from Chicago. It was not the purpose to attempt anything this season, but a trial campaign. An active effort was not put forth to secure a large acreage of beets. The factory is of 350 tons capacity, but will be enlarged as conditions warrant. The beets grown for it this season were satisfactory in quality and quantity. The results of the campaign were suffi-

ciently encouraging to warrant a greater effort for next campaign and confidence in the future success of the enterprise. The factory began operations October 15.

#### MICHIGAN.

This State still continues to hold a larger number of beet-sugar factories than any other. It has installed since the beginning of the industry twenty-four factories. Of this number four have been moved to other places in the United States and Canada, two more are to be removed, and another is idle. These removals were largely due to the establishment of too many factories in districts where the farmers lacked experience in beet growing. The installation proceeded too rapidly. The first factory was installed at Bay City in 1898. The others were built in rapid succession. Michigan's development agriculturally was not sufficient to justify this rapid industrial growth. The locations of those in operation in the State at the present time and their capacities are shown in the following table:

	Tons.		Tons.
Bay City.....	500	Carrollton.....	800
Caro.....	1,200	Salzburg.....	400
West Bay City.....	600	Sebewaing.....	600
Alma.....	750	Mount Clemens.....	600
Holland.....	350	Croswell.....	600
Marine City.....	350	Menominee.....	1,000
Lansing.....	600	St. Louis.....	600
Owosso.....	1,000	Blissfield.....	600

At Bay City there are two plants—one known as the "Michigan" with 500 tons daily capacity, and another known as the "Bay City" with 600 tons daily capacity. The ownership of the two was merged in a company known as the Bay City-Michigan Sugar Company. The "Michigan" factory has been idle for the past two campaigns. Beets grown for both are worked at the "Bay City" plant.

Gradually the State is developing its resources to the point of supplying the factories now in operation. Each year adds additional experience to the beet growers. They are becoming more accustomed to the crop, are appreciating the advantages to a greater extent, and tending to produce a larger supply of beets. The factories in this State must content themselves, however, with shorter campaigns and smaller supplies of beets than those in any other section of the country. Persistently the State is developing a permanent class of beet growers who are gradually increasing their plantings each year. At this time it appears probable that beet growing will eventually develop to the extent of supplying the present factory capacity. Until such time, factory building is not likely to occur to any extent. However, a new factory was built at Blissfield, and was operated during the past campaign for the first time. Some of the factories procured more than the

usual amount of acreage while others were still below the normal amount.

Weather conditions throughout the State were quite favorable to early planting and germination of the seed, but not so favorable to growth in the early summer on account of excessive rains and cold wet weather generally. This delayed the work of bunching, thinning, and weeding beets, throwing the farmers behind with their work. As a rule the fields here are not large, which is an advantage under such conditions. In some places floods have occurred, washing the beets out and destroying the crops entirely. The weather the latter part of the season became uniformly favorable to the beet crop. Throughout October and November, in fact most of the harvesting period, weather conditions were ideal. This maintained the quality of the beets and enabled the farmers to get out their crop in better condition and at less expense than usually.

**BAY CITY.**—Cold wet weather interfered with planting, throwing the crop backward in its growth. The management made an earnest endeavor to secure sufficient acreage to run the Bay City plant during an ordinary term. Material losses occurred in the planted areas caused by heavy rains. Although this is the oldest beet-growing district in the State, beet culture and the interests of the industry have not developed in accordance with the deserts of the district. This is due largely to the proximity of several factories in the district, all demanding beets from so limited a farming area. The company began slicing October 12 and closed December 20.

**CARO.**—The plant at this place has been more than ordinarily successful, as compared with others in the State. It experienced considerable difficulty during the planting season the latter part of May and early part of June, on account of excessive rains and wet cold weather. This did not do so much damage to beets that were actually planted, but it prevented the planting of some fields. The weather during the latter part of June became quite favorable to beet culture and continued so the remainder of the season. With the rest of the factories of Michigan, the district enjoyed favorable harvest conditions. Under test, beets showed more than the usual quality. The factory commenced slicing October 19.

**WEST BAY CITY.**—The season was not considered favorable, there being too much cold, rainy weather. Conditions were quite favorable for harvest. The sugar contents and purity of the beets were higher than usual. The plant finished slicing December 10.

**ALMA.**—The plant at this place has been well managed and generally considered quite successful. On account of excessive rains early planting was prevented. The company secured contracts for a large acreage, but rains prevented the planting of some of this. Later in the season weather conditions became more favorable. A better



crop was raised in the district than was anticipated. Farmers have taken to beet growing more generally than around most of the factories in the State. The influence of the industry is felt throughout the district. Roads have been improved, and farm rents and land values have increased. The campaign began October 29 and closed December 23.

HOLLAND.—The sugar factory at this place has been one of the most successfully conducted in the State. Sufficient acreage for a supply of beets was secured with very little effort. The contracts covered about 3,700 acres. The season opened favorable for planting, after which came weather too cold and wet for successful beet growing. In some places the beets were washed out by floods, making replanting necessary. Fortunately the flooding occurred early. It was estimated that about 85 per cent of the acreage originally contracted for was harvested with normal yield.

MARINE CITY.—The acreage reported as secured was 5,000 acres. The acreage covered by its contracts was sufficient if weather conditions had been more favorable. The cold, wet weather in the early part of the season delayed the crop somewhat. A favorable change of the weather occurred in July. The yield was not as satisfactory as anticipated. A considerable quantity of beets are shipped to this plant from Canada. The campaign started October 17, but was comparatively short.

LANSING.—Beet planting was conducted in this district under quite favorable circumstances, but, like many other portions of the State, it experienced in June heavy rains which washed out the beets and prevented the farmers working the fields. The factory contracts covered about 5,000 acres. During the latter part of June weather conditions became quite favorable to beet production. The crop generally was above normal. The factory commenced slicing October 17.

Owosso.—Eight thousand acres of beets were contracted. About one-seventh of this was near enough for the beets to be delivered by wagon, the rest of the beets reaching the factory by rail. Considerable replanting was necessary on account of unfavorable weather conditions in the early part of the season. These conditions also affected other crops materially. The beet crop matured with fairly good results. The factory was able to work about three-fourths of an average campaign.

CARROLLTON.—The factory at this place secured about 7,000 acres under contract. It arranged for many Russian families to work in the beet fields. These proved quite effective in cleaning the beets of the weeds and grass and getting them into a healthful state of growth by cultivation. As the season progressed the weather became more favorable for beet production in the district. The results were better.



than anticipated. In order to facilitate the delivery of beets the factory established delivery weighing stations in several different towns to accommodate the areas growing its beets. This year's crop in Saginaw County, while fair, has been by no means good.

**SALZBURG.**—This factory is probably the most uniformly successful plant in the State. It is organized on the cooperative plan. Most of the farmers growing the beets are stockholders of the concern. For this reason a greater interest is generally manifested. Growers were considerably discouraged in the early part of the season on account of the cold rains, which interfered with planting and germination, and retarded the growth of the beets, and at the same time facilitated the growth of weeds and grass. Weather conditions improved gradually after the first of June, continuing superb throughout July and August. Conditions were quite favorable to ripening and harvesting. The plant closed its campaign December 9 with results better than anticipated.

**SEBEWAING.**—The factory at this place secured a large acreage for beets. Wet weather in the early spring interfered somewhat with planting beets in the district. Their growth was also more or less retarded by excessive rains. With the weather more favorable from the middle of July on, the situation appeared more encouraging.

**MOUNT CLEMENS.**—The factory at this place secured a fairly good acreage under contracts. As in most places in Michigan, planting was interfered with and retarded by the action of rains and later cold weather. Some of the fields became too weedy to cultivate on this account. The factory began slicing beets October 23.

**CROSWELL.**—Four thousand acres of beets were contracted for, 800 acres being in the vicinity of Croswell. The farmers were able through the aid of favorable weather to get most of their beets planted early. Cold, wet weather followed, retarding to some extent the development of the crop. The Croswell factory closed its campaign about December 1.

**MENOMINEE.**—This is one of the most northerly factories in the State and one of the most recently installed. A good portion of its beets is grown in the State of Wisconsin. Along with the factories farther south it experienced unusual rains during the planting season, but came through in fair shape for maturing a crop after the season became more favorable. Results in the fields were better than anticipated. The factory campaign was more than usually satisfactory.

**ST. LOUIS.**—After meeting with the unfavorable early weather conditions, the acreage planted to beets developed under better weather later on. The factory was able to procure ordinary acreage. Beet deliveries began October 10. The factory started slicing October 30 and finished December 28.

BLISSFIELD.—While the factory at this place was constructed this year and entered the campaign for the first time, many of its beet growers had enjoyed considerable previous experience in producing beets for the factory at Fremont, Ohio. Considerable of the acreage growing beets for this factory is in that State. Some of its growers have also grown beets for factories in other localities. It procured a fair acreage for a first campaign. The season may be rated as fairly favorable. This district produced a bountiful supply of beets. It is estimated that 6,000 acres were planted. The campaign began November 21.

EAST TAWAS.—It was decided that, unless the company operating here could secure sufficient acreage by April 15, the plant would be closed down and the beets grown for it shipped to other factories. It was decided in May, on account of small acreage contracted for, not to operate the plant during the present season. However, the farmers making contracts were encouraged to grow beets, the factory accepting them as per contract and delivering them to Bay City to be worked up. It was deemed advisable by the management to foster beet growing as much as possible with a view to making a greater effort in future. Scarcity of laborers for the fields was one of the main obstacles causing the farmers to refuse to make contracts.

#### NEBRASKA.

The State of Nebraska was the second to produce sugar from beets. Sixteen years ago the first factory was installed at Grand Island with a capacity of 350 tons. This was followed by one at Norfolk, in 1891, with a capacity of 350 tons, and in 1899 by still another at Leavitt of 500 tons daily capacity. These factories were all located in the eastern half of the State. During the period of their operation a part of the time has been marked by excessive drought, another by excessive rainfall, and still another by diseases affecting the beet crop. Under normal conditions sugar production in that section of the State has always proven quite satisfactory.

The factory at Norfolk was recently removed to Lamar, Colo., and there enlarged and improved. The opinion is quite generally current that the plant was removed from Norfolk on account of adverse conditions. An investigation of the facts demonstrated this to be an error. Taking the factory's record from beginning to end, it was quite satisfactory, both to the management and to the farming districts generally. But the owners of the plant possessed a large tract of land along the Arkansas River in Colorado. They had planned to establish a series of factories in this Colorado district to develop its resources. Under their policy it was preferable to remove the plant from Norfolk and place it in commission at Lamar. No doubt under the circumstances it is serving the purpose of its owners in its present

location much more satisfactorily than if it had remained at Norfolk. The farmers around Norfolk who formerly grew beets for that plant continued to produce nearly as much as before, these beets being shipped by rail to the factory at Leavitt.

It does not appear, therefore, as if conditions adverse to beet production caused the plant to be removed. There has been considerable local discussion around Norfolk regarding the establishment of a new sugar factory at that point. I look upon it as a real opportunity. A large part of the work of educating the farmers has been accomplished. With the removal of the former plant a demonstration has been made to the beet growers of their loss. A factory there now would receive sympathy and support from the farmers and others.

One of the lessons taught by Nebraska's experience in sugar production is the value of the refuse products of the factory for feeding purposes. Around all these factories are fed large flocks of sheep and herds of cattle. The experience of these factories will eventually be that of others in the United States. During the first few campaigns very little of the pulp was fed, but it grew gradually into favor, and now it may be said that its use is quite common and the pulp is generally sought after.

The plant at Leavitt increased its daily capacity for working beets from 500 to 1,100 tons. This improvement was equal to building another large plant in the State this year. Nearly all plants of ordinary capacity like the one at Leavitt are constructed in such a way that doubling the capacity simply means the introduction of machinery sufficient for that purpose. A large increase in the production of sugar from year to year in this country is brought about in this way. Such growth is not so apparent to the public but is effective in building up the beet-sugar industry.

Throughout the growing period considerable difficulty was met in procuring sufficient labor. Nebraska beet factories early began the practice of stimulating immigration of foreign labor to the beet-growing areas. The influence of this work is felt to-day in the continuous influx of this class of labor. The beet growers of other States are aware of this and are constantly calling upon Nebraska beet-growing districts for a part of this labor supply. This tends to absorb a large portion of it. Further extension of the sugar industry seems more likely to occur in the western part of the State, where irrigation is more or less developed.

GRAND ISLAND.—The American Beet Sugar Company here has a factory of 350 tons daily capacity. It was one of the original factories of the country, and has operated through many campaigns. Many of its beets are grown in the western part of the State, where irrigation is in vogue. Wet and inclement weather, followed by more or less hail, destroyed some of the plantings. The season, however, improved ma-



terially later on and continued quite generally favorable throughout. A sufficient acreage was procured. This, coupled with the fact that beets returned a normal yield, gave the plant a good working campaign. The factory started October 9 and closed January 3. Many improvements were made at the factory during its interval of rest.

LEAVITT.—A factory of 500 tons was located at this place in 1899. In its equipment it is the newest and most modern of the two plants now in the State. It is located in a heavy corn-producing belt, in which stock feeding and fattening is carried on extensively. This fact is due largely to the installation of this plant by a large stock-producing concern. Its capitalization was inspired for the purpose of securing pulp without freighting it long distances. For the last two or three years the bulk of its supply of beets has come from the western part of the State—from North Platte, in Lincoln county, and McCook, in Red Willow County. The season opened with the factory possessing a larger contracted area than at any time in its history. The supply of beets gave it a campaign more extensive than any other since it was built. During the season its capacity was increased to 1,100 tons of beets daily. It is estimated that the factory contracted for nearly 15,000 acres of beets. After receiving this much it refused to take any more. The season throughout the beet-growing area was quite favorable for planting and germination of the seed. Then too much rain occurred, followed by cold weather, which interfered to some extent with cultivation and plant growth. In addition to this some damage by hail was done to the young and tender plants. The webworm was in evidence to a greater or less extent, but did not do considerable damage. Heavy rains occurred in September. This tended to retard ripening of the beets, and consequently the beginning of the campaign. The factory started October 18. The weather was quite favorable during the harvesting season.

#### NEW YORK.

The sugar industry has been operating to some extent in the State for a considerable time. It has had to contend with many things not present in the districts farther west. Agriculturally the State is largely devoted to the growing of crude products to supply manufacturing industries. Here we find gardening, dairying, creameries, canning, malting, preserving, and many other industries directly related to farming, particularly farming of the more intensive sort. Here the growth of the beet-sugar industry must of necessity be much slower. But there are many reasons why it should develop into a great industry. Other industries which could use the by-products of the sugar factory are already established—such, for instance, as dairying. The nearness and extent of the market is one of the greatest advantages offered to sugar production in the State of New York. The experi-



ment station through many tests of its soil conditions has proven them generally favorable. Two factories have been operated in different parts of the State for some time. The results have done much to establish conditions favorable to the sugar industry. One of these located at Binghamton, having a capacity of 400 tons, ran for several years, but was finally moved to Black Hawk, Idaho, where it could more readily secure the necessary beets. Another one of 350 tons' capacity has been operating at Lyons, N. Y. Another smaller one several years ago was established at Rome and operated for two or three campaigns. Its capacity was small, and this, coupled with difficulty in securing sufficient beets, caused it to close down, and it never reopened.

The legislature by State bounty has appropriated considerable money to foster the industry. One advantage enjoyed by these factories has been the readiness of farmers to buy the pulp from the start. It is readily sold in large quantities for 50 cents per ton and at retail for \$1. When it is considered that in the production of sugar every factory turns out one-half ton of pulp for every ton of beets worked the importance of this can readily be appreciated. For instance, take a 600-ton plant; turning out 300 tons of pulp every day, worth \$300. In an ordinary campaign of 100 days this would amount to \$30,000. The feeders in New York are accustomed to feeding by-products from the breweries, starch factories, and malt works, and hence readily appreciated the value of beet pulp.

LYONS.—After considerable difficulty and adverse experience this factory (whose capacity has recently been increased to 600 tons of beets daily) has finally secured success in its campaigns. It had to meet and overcome the competition with the growers of special crops. For the past campaign it had contracts covering an area of 5,800 acres. Weather conditions were generally considered favorable during seeding and germination. The crop was quite satisfactory. The factory began operations October 3.

As an inducement to grow beets this company offers the farmers pulp to the extent of 50 per cent of the weight of beets delivered. This is practically giving the producers of the beets about all the pulp they produce—that is to say, the farmer sells the sugar out of his beets to the factory and retains for his stock that part which is valuable for feeding.

#### OHIO.

FREMONT.—For several years a factory of 350 tons capacity has been operated at this point. Its history is quite similar to that of the New York factories. It required considerable effort to educate the farmers to the point of finally producing enough beets to supply it for a campaign. In order to do this, farming districts were worked up in

different directions, generally west. The by-products of the sugar factory for feeding purposes were readily appreciated. Gradually beet growing grew in favor until now the factory is receiving an adequate supply of beets, and is one of the most successful concerns in the country. It has not only built up a sufficient beet-growing area for itself, but it has done much to stimulate beet growing in western Ohio and southeastern Michigan, where recently a factory was built at Blissfield. There is also considerable talk and negotiations among interested parties with a view to establishing a factory in western Ohio at Defiance. This is largely the result of the work of this factory. The plant was considerably improved during the year.

The season throughout was generally favorable. In the early part it was too wet with continual cold weather affecting more or less the planting and cultivation, but as a rule the season may be rated as favorable. The factory secured about 4,000 acres under contract and commenced slicing beets October 12.

#### OREGON.

The experiment station at Corvallis, some years ago, conducted exhaustive experiments to test the adaptation of different parts of the State to the beet-sugar industry. It was developed that in several sections conditions were naturally favorable. One factory of 350 tons capacity was established in the eastern part of the State, at Lagrande. The real drawback to further development has been the lack of transportation facilities in the valleys and other areas suited to beet growing. Farming methods as a rule are not up to standard. Any new beet-sugar enterprise in this State must necessarily educate the farmers up to the point of sustaining the sugar industry.

LAGRANDE.—At Lagrande farmers have been slow to take hold of the work of producing beets. The plant, in order to secure a sufficient supply of beets, has been compelled to work up an interest in beet growing in districts somewhat remote from the factory. However, the industry has gradually won the confidence of the agricultural producers, and the results have been much more satisfactory in recent campaigns. The work of the factory has raised the whole district to a higher plane of farming, which more nearly meets the requirements of the sugar industry. The factory secured about 4,000 acres under contract for 1905. Most of this land was carefully prepared by fall plowing. An indication of the farmers' appreciation of this institution is the general prevalence of pulp feeding. Very little of it was utilized in the beginning, but last year it was all consumed. The working out of such features as this points strongly to the final and full success of the factory. Much of the land growing sugar beets can be irrigated, if necessity requires. The unusual success attending last year's work

has done much to reinforce the confidence of the farmers. The general feeling toward beet culture is very much improved.

The spring started out a little too cold for best results, but later came better conditions, which prevailed throughout the balance of the growing season. Heavy rains fell during the spring months, supplying sufficient moisture for the early growth of the plants. A late spring frost damaged the beets to some extent, but not very seriously. Quite a number of improvements were made by the factory, among others, enlargement of the beet-storage facilities. On the whole, the season may be classed as more than ordinarily favorable. Although drought was more or less prevalent in the State, frequent showers furnished more than the usual supply of moisture. The farmers have become more adept in the work of cultivation. The factory began slicing September 18.

#### UTAH.

Utah was the third State to enter upon the work of sugar production from beets. In 1891 a factory of 350 tons capacity was installed at Lehi. Four other plants are now located in the State. The establishment of factories in Utah has proceeded along lines entirely different from those in other States, except possibly Colorado. Each new factory in Utah has been the result of a tendency to overproduction of beets stimulated by the work of another factory or factories. This is healthful growth. There can be no guesswork about the success of a factory when its establishment is induced by the actual demands of agriculture. Such an institution does not have to meet the obstacles of pioneer development. The farmers are educated to the point of employing the methods required, and they appreciate the advantages presented by such an institution. From the beginning the work starts off regularly and uniformly like that of old factory districts. It is simply necessary to secure acreage and machinery. The trial work of a few weeks thoroughly establishes a district in sugar production. Such conditions are ideal. Could the industry have been so built up in some of the other States no doubt factory removals would have been unheard of.

The 5 factories in Utah are divided up between two companies. The Utah Sugar Company's plant at Lehi is composed of a main plant with slicing stations at Springville, Spanish Fork, and Provo. The total capacity of this plant is 1,200 tons daily. The slicing stations simply extract the juice from the beets, mix it with limed water, and pump it down to the main plant at Lehi. These stations are located from 10 to 12 miles distant from the main plant. The one at Spanish Fork was installed last year. Piping juices is simply another method of conveying to the factory the crude product. The pipe lines were installed here in order to accommodate with transportation the avail-



able beet-growing districts, when railroad transportation facilities were either lacking or unsatisfactory. Pipe lines have also been used to some extent by one of the factories in eastern Idaho.

The Utah Sugar Company also owns another plant of 1,200 tons capacity at Garland.

The Amalgamated Sugar Company owns three plants: One at Logan of 600 tons daily capacity, one at Ogden of 400 tons, and one at Lewiston of 600 tons. Thus the combined capacity of the factories belonging to the Utah Sugar Company is 2,400 tons of beets daily, and that of the factories belonging to the Amalgamated 1,600 tons of beets daily.

Beets are produced in this State by irrigation. The beet districts are probably accommodated with better systems of irrigation than those of any other place in the country. Winter snow and later rains are the principal dependence for the water supply, and this is generally regular and abundant. The farming area is generally cut up into smaller farms than those found in other places. This produces ideal conditions, as no more beets should be planted than can be taken care of in the best manner.

The season was generally quite favorable, especially in the early part. Along the latter part of July and August an insect pest appeared, doing great damage to the crops. The designation given to this pest locally is the "white fly." Both the experiment station at Logan and the United States Department of Agriculture were called upon for expert entomologists to study the pest. The Utah Sugar Company estimates that its losses due to this cause were quite large. The ravages of the pest extended throughout the beet-growing districts of Utah and southern Idaho.

LOGAN.—A plant of 600 tons daily capacity has been operating for several seasons at this place. Since its installment the capacity of the plant has been doubled. The season opened very favorably, but the weather proved very changeable, being generally unfavorable during most of the growing period. Thirty-five hundred acres were contracted. The plant began slicing September 25. Beets were damaged more or less by drought, blight, and ravages of the "white fly." Owing to these unfavorable conditions the campaign was considerably shorter than for several years.

OGDEN.—A factory of 400 tons daily capacity has been operating at this place. Since its installation it has been very much improved. Among other things, it has added an Osmose plant to secure further extraction of sugar from molasses. As the season progressed considerable damage resulted from drought, blight, and insect pests. The factory began operations September 18, and the campaign closed December 23. The beets were not up to standard in quality and



quantity. The length of the campaign was materially below the normal.

LEWISTON.—A factory of 600 tons daily capacity was installed at this place and put in operation for the first time in 1905. It secured 3,500 acres under contract which, though ordinarily a small acreage for a plant of this kind, proved satisfactory for its first campaign. This factory is located on the northern line between Utah and Idaho on Bear River, from which stream its beet lands receive water for irrigation. Beets have been grown to some extent for some time for the factory at Logan, and more recently for the one at Garland. The conditions affecting this industry have been quite thoroughly tested.

The season opened quite favorable and continued so for some time. Blight appeared to some extent in the beets. They were also injured more or less by the ravages of the "white fly." The plant closed December 12.

LEHI.—The history of his plant has been one of steady growth and prosperity. It has gradually increased its beet-growing area and enlarged its capacity, from 350 tons at the beginning to 1,200 tons at present. During the present season, 11,500 acres were placed under contract. In order to secure further extraction of sugar a Steffens plant was installed and the Osmose plant removed to its factory at Garland. The early season was generally considered favorable to beet planting. This was followed by more or less drought and damage by insect pests, with the result that the harvest was materially below normal, both in quality and quantity. The sugar factory began its campaign October 19 and closed January 20.

GARLAND.—This large factory of 1,200 tons daily capacity is located in the upper part of the State, near Bear River, where it empties into the Great Salt Lake. Beets grown for this factory have always been of high quality, some of its growers usually taking the prize in contests of this character. Its contracted area this season was much larger than ever before, comprising 7,400 acres. The extension of the Malad Valley Railroad is increasing its beet-growing area. The season for planting and germination was most favorable. There were sufficient showers to keep the soil in the proper moist condition and sufficient sunshine to germinate the seeds. Later there was a tendency to drought. Some blight appeared among the beets, and they were also damaged to some extent by the "white fly," the resulting harvest being not as satisfactory as was anticipated in the early season.

#### WASHINGTON.

For the past several years considerable progress has been made in testing the conditions in this State affecting the beet-sugar industry. Many localities have been found favorable to sugar production. In some of them beets for factory use are grown under rain conditions;

others require irrigation to some extent; and still others depend on irrigation almost entirely. The development of agricultural resources in Washington is practically in its infancy. Wheat has been the principal farm product for some years. Conditions of the State are quite favorable to general cropping in those portions where adequate moisture is supplied by rain and in other districts where sufficient water has been developed for irrigation. The development of irrigation has proceeded quite rapidly in the last few years. It seems probable that, with a fuller development of the resources of the State the sugar industry will grow.

WAVERLY.—A factory of 350 tons has been operated here for some time. It was installed at the time when the agricultural resources of the district were not developed. Intensive methods of agriculture were not in vogue sufficiently to meet the demands of the sugar industry. For this reason results at this factory have not been so satisfactory as at some other places. Year by year it has been slowly establishing a permanent list of beet growers who appreciate the value of the crop more and more. It is estimated that about 4,000 acres were placed under contract to grow beets for the factory for 1905. Of this acreage about one-third was grown under the management of the factory itself.

The season started quite favorable and early. Germination was good, and a fair stand of beets was obtained throughout the district. More rain fell than usual in the early growing period, the precipitation being 4 inches in June. During July and August the tendency was to drought. The weather was not only dry, but hot, which materially affected the beet crop. The capacity of the plant was increased during the season from 350 to 500 tons. With the beginning of September more rain fell, to the material benefit of the beet crop.

#### WISCONSIN.

About a decade ago, when the experiment stations of the country were actively investigating conditions for sugar-beet growing in various States, Wisconsin was one of those most active. This work has been continued on quite an extensive scale ever since. In most of the States after the conditions had been determined the experimental work ceased; not so in Wisconsin. Its repeated experiments from time to time tended to check up its former work. The station has conducted feeding experiments to discover the relation of the sugar industry to other agricultural resources and interests of the State. It has carefully compiled very valuable data showing conditions in every part of the State. These have clearly pointed to a large number of districts adapted to beet-sugar production. The State has many natural advantages. It is well watered and drained; its soil is productive. As a rule, it has a good class of farmers. It is well supplied

with railroads running in every direction, furnishing cheap transportation. It also has extensive water transportation facilities. With the Mississippi on the west and the Great Lakes on the north and east, water and rail are brought into active competition with each other, insuring cheap transportation forever. Wisconsin now has 3 factories in operation and another building for 1906, while there are possibilities of a number of others. The location of its factories with their capacities are as follows: Menomonee Falls, 500 tons; Chippewa Falls, 600 tons; Janesville, 600 tons.

**MENOMONEE FALLS.**—A factory of 500 tons daily capacity has been operating here for several years. Through its work in developing conditions the other factories were installed. It induced the farmers of several other districts to plant beets purely for testing conditions and educating the growers. Among these places are Janesville, Madison, and Chippewa Falls. It is the policy of the management of this factory to establish other factories in the State as fast as developing conditions will warrant. Acting on this, it located a factory last year at Chippewa Falls. Others were located at Madison and Janesville by other interests. A larger acreage than usual was secured, insuring the factory's supply of beets.

The weather in the early spring was considered quite favorable. This was followed by a period of excessive rains running through June and July. These adverse conditions interfered with cultivation and the early thinning and bunching of the beets until the plants became too large for this work. This resulted in considerable loss of crops to some beet growers. A new Steffens process was installed this year. The factory began work October 21.

**CHIPPEWA FALLS.**—The factory operating here closed its second campaign this year. It had a contracted area for growing beets of about 4,500 acres. One of the advantages of this district is the large number of contractors growing beets on small areas. I deem this the most natural and logical method of producing beets for a factory for its first campaign. The grower is not burdened with too many details to start with. It gives him a chance to do well the work he undertakes. He can assume greater responsibilities as he becomes accustomed to the work. He is less liable to become discouraged. On these small contracts farmers take considerable pains to prepare their land properly in advance. All this preliminary work has a tendency to lessen the work of cultivation further along, and is especially helpful to beets in their early growth or tender stage.

The early season started out quite favorably. Rains were frequent and sufficient, and, where good cultivation obtained, crops were exceptionally good. The factory opened October 4, and began slicing October 14.



JANESVILLE.—The factory at this place made its second campaign in 1905. The location of a factory here was attended with considerable natural advantages. For many years this has been a tobacco-growing district. The cultivation of tobacco, like that of sugar beets, requires considerable care both in preparation of the plant bed and in rearing the plants. This involves considerable expense in the production of a crop. It is much easier for a grower accustomed to such intensive methods to take up beet growing. A large portion of the beet acreage this year was furnished by experienced tobacco growers on this old well-cultivated tobacco land. The good results in beet production have been all that was anticipated. More or less feeling has been engendered between the growers of these two crops. My own idea is that in the end both crops will be benefited, as it is not advisable to grow the same crop on the same land for several consecutive years. It will be found that growing these two crops together in rotation with other things will tend to produce the very best results with both. It keeps the land in a higher state of tilth and fertility.

It is estimated that the factory secured contracts for about 6,700 acres. The weather was a little cold in the early part of the season, but changed and continued favorable throughout the rest of the growing period of the beets. Harvesting weather was ideal. Some heavy rains fell the first part of October, after which it settled down to excellent conditions until the close of the harvest. Of the area contracted about 6,000 acres were harvested.

#### **PRESENT DEVELOPMENT OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES.**

It will be interesting at this time to consider the present development of the beet-sugar industry. I propose to offer a few tables that will tend to show its status at the present time. But tables can not indicate the influence of the industry in promoting irrigation, immigration, land settlement, the building of railroads and trolley lines, the making of other improvements, and the upbuilding of various industrial enterprises. Such results can only be appreciated by those who have visited the factory districts in Colorado, Utah, and Idaho, or in other newly settled and improved districts throughout the West.

The following table shows the number of factories with their capacities by States and the new factories under construction with their locations and capacities:



*Beet-sugar factories built or building in the United States, March, 1906.*

State.	Num-ber.	Capacity.	State.	Num-ber.	Capacity.
<i>Factories in operation.</i>			<i>Factories now building.</i>		
		<i>Tons.</i>			<i>Tons.</i>
California.....	6	8,400	Arizona, Glendale.....	1	800
Colorado.....	12	9,200	California:		
Idaho.....	3	3,000	Visalia.....	1	350
Illinois.....	1	350	Hamilton.....	1	1,000
Michigan.....	16	10,550	Colorado:		
Nebraska.....	2	1,450	Brush.....	1	600
New York.....	1	600	Fort Morgan.....	1	600
Ohio.....	1	400	Swink.....	1	1,200
Oregon.....	1	400	Idaho, Nampa.....	1	600
Utah.....	5	4,000	Kansas, Garden City.....	1	1,000
Washington.....	1	500	Montana, Billings.....	1	1,200
Wisconsin.....	3	1,700	Minnesota, Chaska.....	1	600
			Michigan, Charlevoix.....	1	600
			Wisconsin, Madison.....	1	600
Total factories in oper- ation.....	52	40,550	Total factories building.	12	9,150
<i>Factories not operating.</i>			Grand total for the United States.....		
California.....	1	1,200		68	52,600
Michigan.....	3	1,700			
Total factories not op- erating.....	4	2,900			

Some of these factories work 150 days in a campaign and others but 45. Assuming that all worked under normal conditions and made average campaigns of 100 days, the 68 factories listed would work in a season 5,260,000 tons of beets; the farmers would receive for beets at the usual average price \$26,300,000, and would pay for labor at least half this amount, or \$13,150,000.

At a fair estimate, these factories have cost investors \$52,600,000; for lands, railroads, irrigating ditches, live stock; and in other supplemental investments the beet-sugar companies have expended on a fair estimate \$12,137,500, making their total investment \$64,737,500. They employ on a fair estimate a working capital of \$26,300,000, which added to their total permanent investment makes a total capital used in the beet-sugar industry, at the present time, of \$91,037,500.

These factories use 1,052,000 tons of coal annually, valued at \$3,156,000, and 526,000 tons of lime rock, valued at \$1,578,000.

We can not estimate the amount paid for other crude supplies, the amounts paid to railroads for transportation, etc., nor can we begin to estimate the value of the benefit conferred on subsidiary enterprises and general mercantile business.

#### CONSUMPTION OF SUGAR IN 1900 COMPARED WITH THE ESTIMATED PRODUCTION IN 1906.

By means of graphic illustrations and statistical tables I will now endeavor to show the magnitude of the sugar industry of the United States, including the production of both cane and beet sugar. I will first try to portray the situation in the area west of the Mississippi. For this purpose I have made a careful estimate of the production for 1906, including the new beet-sugar factories which will be in opera-

tion and assuming that all these factories will run at their full capacities for campaigns of 100 days, assuming also that the production of cane sugar will be the same as in 1905. This estimated production of the entire area west of the Mississippi River for 1906 exceeds the estimated consumption of sugar in the same area for 1900 (the last date for which we have reliable census figures). This furnishes a striking demonstration of the rapid growth of the beet-sugar industry in this area.

It will be noted that the estimated sugar production in the territory west of the Mississippi for 1906 is about 28 per cent greater than the actual production for 1905. That this increase is within the range of possibility is evident when we consider that in this territory at least 10 new factories will begin the manufacture of beet sugar in 1906, increasing the total number to 40, and that the total capacity of all the beet-sugar factories in this area will be increased about 29 per cent. As in 1905 more than a dozen of these western factories made campaigns of more than 100 days (the average for all being 85 days), a favorable season may result in a crop of beets sufficiently large to enable a greater number of these factories to exceed the campaign limit assumed. Moreover, there may be a considerable increase in the product of cane sugar. These considerations indicate that the production for 1906 may possibly exceed the estimates used in these tables.

It would, of course, be more satisfactory to compare the estimated production of sugar for 1906 with the estimated consumption for the same year, but this seems impracticable owing to the absence of population statistics for any year later than 1900, the last census year. It has therefore been thought best to use the figures of 1900 for population and consumption of sugar. It should, of course, be borne in mind that since the year 1900 there has been a considerable increase of population in this western half of the country and a corresponding increase in consumption of sugar, so that the actual excess of production over consumption must be less than is shown by these tables.

In my report for 1901 I made a similar comparison, using the actual figures for production of that year, the result being that the total production for the whole country was 442,000,000 pounds *less* than the consumption west of the Mississippi for 1900. If the estimates I have made for 1906 are realized, the total production for the whole country (as shown on p. 79) will be 369,000,000 pounds *more* than the consumption west of the Mississippi in 1900, an increase in production of more than 810,000,000 pounds (405,000 short tons) in five years.

The States are mapped in groups from west to east, as follows:

GROUP I: Coast States—Washington, Oregon, California.

GROUP II: Idaho, Nevada, Utah, Arizona.

GROUP III: Montana, Wyoming, Colorado, New Mexico.

GROUP IV: North Dakota, South Dakota, Minnesota, Iowa, Missouri, Nebraska, Kansas, Oklahoma, Indian Territory, Texas, Arkansas, Louisiana.

Three items enter into the statistical data of each State and Territory: (1) Population; (2) consumption; and (3) estimated production based on present capacities of factories and an average of 100 days for the campaign.

Population is taken from the report of the Twelfth Census (1900).

The per capita consumption is derived by dividing the total consumption by the total population in the United States.

The amount of sugar consumed is found by adding to the amount of importations, as shown by reports of the United States Treasury Department, the amount of sugar produced in the United States.

The consumption for each State is estimated by multiplying the number of inhabitants by the per capita consumption.

Finally, all groups in the diagram are brought together to show the total production and consumption of all the States and Territories west of the Mississippi River.

In these tables, after the first the totals are carried forward so as to facilitate comparison of production and consumption of sugar not only by States and groups but by combinations of groups.

#### GROUP I.

The accompanying map for Group I (fig. 1) represents that part of our country bordering on the Pacific Ocean, each of the three States producing sugar to a greater or lesser extent. California was one of the first States in the Union to produce sugar from beets. Washington has one factory and Oregon one. In each of these States it has been reliably demonstrated that there exist proper conditions for greatly increasing the output of sugar. Especially is this true of Washington and California. There are prospects for the establishment of several new factories in the territory represented by this group. Considerable cane sugar from Hawaii has been refined annually

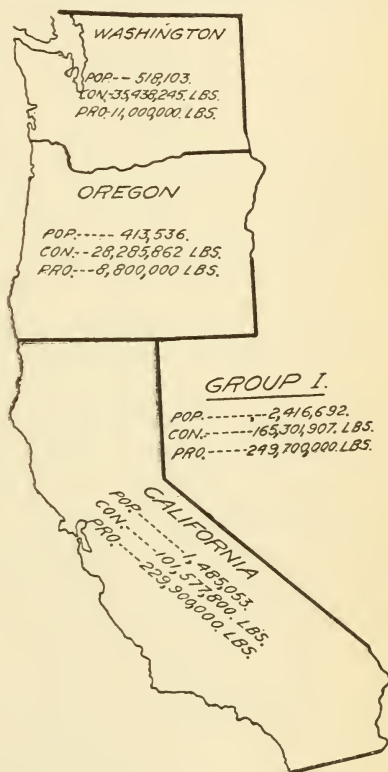


FIG. 1.—Population (1900), consumption of beet sugar (1900), and estimated production of beet sugar (1906) in the Pacific Coast States.



in California, some of it entering into consumption in the coast and inter-mountain States. Of the three States, production in California alone exceeds consumption. These figures show that the total consumption of sugar for 1900 in this group is 84,398,093 pounds less than the estimated production for 1906, provided the conditions of the estimate are realized.

GROUP I.—*Population in 1900, estimated consumption of sugar for 1900, and estimated production of beet sugar in 1906 on the assumption that all factories run at their full capacities for campaigns of 100 days.*

State.	Population in 1900.	Consumption of sugar in 1900.	Estimated production of beet sugar in 1906.
		<i>Pounds.</i>	<i>Pounds.</i>
California.....	1,485,053	101,577,800	229,900,000
Washington.....	518,103	35,438,245	11,000,000
Oregon.....	413,536	28,285,862	8,800,000
Totals.....	2,416,692	165,301,907	249,700,000

#### GROUP II.

Group II (fig. 2) represents that district which includes the States of Idaho, Nevada, and Utah. To this group is added the Territory of Arizona. The development of the beet-sugar industry has proceeded quite rapidly in most of this area during the last few years. Sugar production from beets has been carried on quite extensively in Utah for several years. The production in this State three years ago represented the entire amount for the group. Since then, two large factories have been built in Utah, four have been installed in Idaho, and a factory of large capacity is building in the Territory of Arizona. It is definitely settled that an additional factory will be built in 1906 in the State of Idaho. There is some probability that another new factory will be established in Utah and one in Nevada. The united totals for Groups I and II show that the consumption of sugar in these groups in 1900 is less by 227,903,968 pounds than the estimated production for 1906, provided, of course, the favorable conditions of the estimate are realized.

GROUP II.—*Population in 1900, consumption of sugar for 1900, and estimated production of beet sugar in 1906 on the assumption that all factories run at their full capacities for campaigns of one hundred days.*

State or Territory.	Population in 1900.	Consumption of sugar in 1900.	Estimated production of beet sugar in 1906.
		<i>Pounds.</i>	<i>Pounds.</i>
Idaho.....	161,772	11,060,280	79,200,000
Nevada.....	42,335	2,895,714	.....
Utah.....	276,749	18,929,651	88,000,000
Arizona.....	122,931	8,408,480	17,600,000
Totals for Group II.....	603,787	41,294,125	184,800,000
Totals for Group I.....	2,416,692	165,301,907	249,700,000
Totals for Groups I and II.....	3,020,479	206,596,032	434,500,000



GROUP III.

We find in Group III (fig. 3) the Rocky Mountain States—Montana, Wyoming, Colorado, and the Territory of New Mexico. Although this group represents a comparatively new section of the United States, in the last few years it has made wonderful strides in the development of the beet-sugar industry, and this has induced a general tendency to rapid development agriculturally and industrially throughout the entire district. Colorado stands at the head of the list as the heaviest producer of beet-sugar. It has 12 factories in operation, 2 more build-

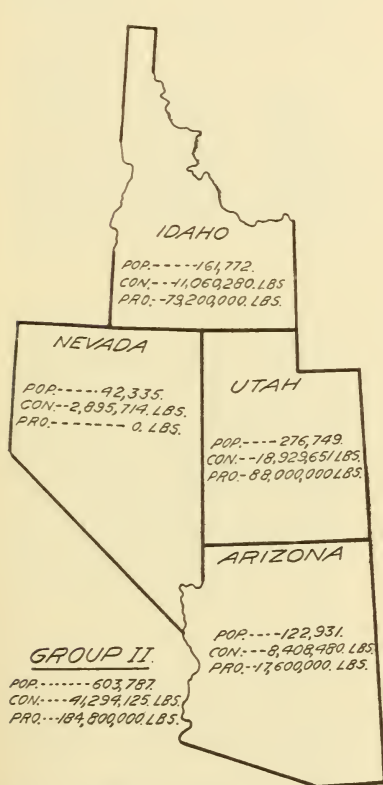


FIG. 2.—Population (1900), consumption of sugar (1900), and estimated production of beet sugar (1906) in the Great Basin States and Arizona.

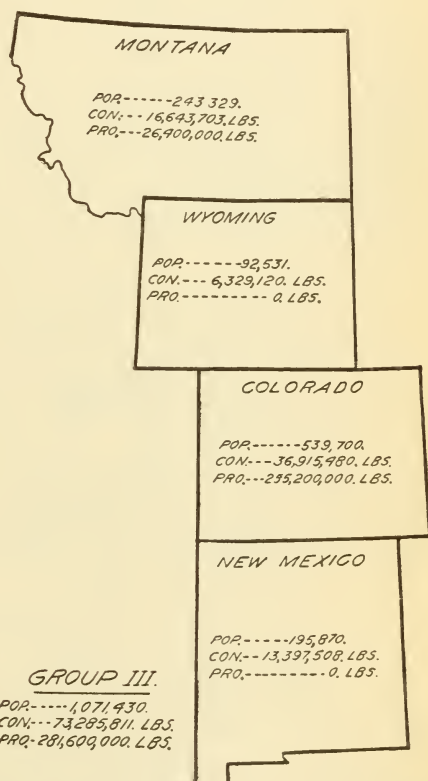


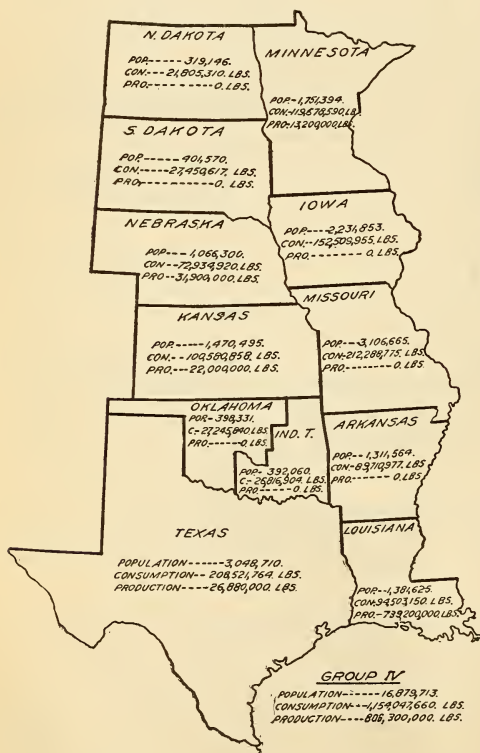
FIG. 3.—Population (1900), consumption of sugar (1900), and estimated production of beet sugar (1906) in the Rocky Mountain States and New Mexico.

ing, and several others under very active contemplation. In addition to this, Montana is entering the field. At present 1 factory is under construction and the establishment of others is receiving consideration. The conditions are quite similar to those of Colorado, and the experience of the beet-sugar industry in that State is very likely to be repeated in Montana in the very near future. A similarity of conditions in Wyoming is also influencing favorable prospects for fac-

tory installation in that State in the near future. The consumption of sugar for 1900 in this group is less by 208,314,189 pounds than the estimated production for 1906, provided all the factories run at their full capacity for campaigns of one hundred days; and the combined total production of beet-sugar in Groups I, II, and III will exceed the amount of sugar consumed in 1900 by 436,213,157 pounds.

GROUP III.—*Population in 1900, consumption of sugar for 1900, and estimated production of beet sugar in 1906 on the assumption that all factories run at their full capacities for campaigns of one hundred days.*

State or Territory.	Population in 1900.	Consumption of sugar in 1900.	Estimated production of beet sugar in 1906.
Montana.....	243,329	<i>Pounds.</i> 16,643,703	<i>Pounds.</i> 26,400,000
Wyoming.....	92,531	6,329,120	.....
Colorado.....	539,700	36,915,480	255,200,000
New Mexico.....	195,870	13,397,508	.....
Totals for Group III.....	1,071,430	73,285,811	281,600,000
Totals for Groups I and II.....	3,020,479	206,596,032	434,500,000
Totals for Groups I, II, and III.....	4,091,909	279,881,843	716,100,000



#### GROUP IV.

In Group IV (fig. 4) Nebraska, with two factories (and a fair prospect for the building of others), is the leading State in the production of beet sugar. In Minnesota, where beet sugar has been produced for many years, the only factory (at St. Luis Park) was destroyed by fire in 1905. Its place will almost certainly be taken by a factory at Chaska in 1906. A large new factory at Garden City, Kans., is also a practical certainty, and its product is included in the estimate.

In Louisiana the cane-sugar factories produced last year 739,200,000 pounds, and in Texas an additional 26,880,000 pounds was produced, making a total of 766,080,000 pounds of cane sugar produced.

FIG. 4.—Population (1900), consumption of sugar (1900), and estimated production of sugar (1906) in the group of States and Territories lying between the Mississippi River and the Rocky Mountains.

GROUP IV.—*Population in 1900, consumption of sugar in 1900, and estimated production of beet sugar and cane sugar in 1906.*

State or Territory.	Population in 1900.	Consumption of sugar in 1900.	Estimated production of sugar in 1906.
<b>BEET SUGAR.</b>			
		<i>Pounds.</i>	<i>Pounds.</i>
North Dakota.....	319,146	21,805,310	.....
South Dakota.....	401,570	27,450,617	.....
Minnesota.....	1,751,394	119,678,590	13,200,000
Iowa.....	2,231,853	152,509,955	.....
Missouri.....	3,106,665	212,288,775	.....
Nebraska.....	1,066,300	72,934,920	31,900,000
Kansas.....	1,470,495	100,580,858	22,000,000
Oklahoma.....	398,331	27,245,840	.....
Indian Territory.....	392,060	26,816,904	.....
<b>CANE SUGAR.</b>			
Texas.....	3,048,710	208,521,764	26,880,000
Louisiana.....	1,381,625	94,503,150	739,200,000
Arkansas.....	1,311,564	89,710,977	.....
Totals for Group IV (beet sugar).....	16,879,713	1,154,047,660	67,100,000
Totals for Groups I-III (beet sugar).....	4,091,909	279,881,843	716,100,000
Totals for Groups I-IV (beet sugar).....	20,971,622	1,433,929,503	783,200,000
Total cane sugar in Louisiana and Texas.....	.....	.....	766,080,000
Total production of sugar for Groups I-IV.....	.....	.....	1,549,280,000

GROUPS I TO IV COMBINED.

The accompanying illustration (fig. 5) shows the area of Groups I to IV combined. The data included in the table given under Group IV show that the total estimated production for 1906 of beet sugar in the area west of the Mississippi will be 783,200,000 pounds; of cane sugar, 766,080,000 pounds; and the total production of sugar 1,549,280,000 pounds, or over one and one-half billions. The estimated production for 1906 in the entire area west of the Mississippi will exceed the estimated consumption for 1900 by 115,350,000 pounds (57,675 short tons).

AREA EAST OF THE MISSISSIPPI.

Beet sugar is produced in five States east of the area included in Groups I-IV. Michigan has sixteen active factories and her product of beet sugar exceeded that of California in 1903 and again in 1904. Another factory (at Charlevoix), nearly completed, will probably be engaged in production in 1906, and still another, which has been idle, is expected to resume operations. Wisconsin has three successful factories, and will certainly have four for the campaign of 1906. New York, Ohio, and Illinois each has one factory.

As the factories east of the Mississippi have always made shorter campaigns on an average than the western factories (the average for the twenty-two factories being sixty-five days in 1905), it would hardly be safe to estimate the production for 1906 on the basis adopted in the foregoing estimates. This figure is therefore reduced to seventy-five in estimating the yield of the eastern factories for 1906.

*Estimated production of beet sugar east of the Mississippi River in 1906 on the assumption that all factories will run at their full capacities for campaigns of seventy-five days.*

	Pounds.
Illinois.....	5, 775, 000
Michigan.....	193, 875, 000
New York.....	9, 900, 000
Wisconsin.....	37, 950, 000
Ohio.....	6, 600, 000
Total .....	254, 100, 000



FIG. 5.—Population (1900), consumption of sugar (1900), and estimated production of sugar (1906) in the entire area west of the Mississippi River.

It is easily possible that this estimated production of sugar might be exceeded in 1906; at any rate, it is a reasonable probability that it may be equaled by the actual results.

#### THE ENTIRE UNITED STATES.

From the figures given in the foregoing tables we can now make up a table showing the estimated total production of sugar in the United States in 1906.



*Estimated total production of sugar in the United States in 1906.*

	Pounds.
Beet-sugar production west of the Mississippi River.....	783, 200, 000
Beet-sugar production east of the Mississippi River.....	254, 100, 000
<hr/>	
Total beet-sugar production.....	1, 037, 300, 000
Total cane-sugar production.....	766, 080, 000
<hr/>	
Total sugar production.....	1, 803, 380, 000

As the estimated consumption of sugar west of the Mississippi in 1900 (the last census year) was 1,433,929,503 pounds, it will be seen that the total estimated production of the entire country for next year (1906) exceeds that by a little over 369,450,000 pounds or 184,725 short tons. This shows what rapid progress is being made toward supplying our entire home demand for sugar.

**PROBABLE FUTURE OF THE INDUSTRY IN THE UNITED STATES.**

The development of this industry during the past few years has been of a substantial and progressive character. No factories have been installed on guesses or assumptions in regard to the conditions. During the past five years factory building has extended wholly in response to developed conditions. Every new factory has been built to meet a demand induced by actual production of beets for factory use. Factories established under such conditions move along regularly and smoothly from the start. During the first season there is always to be anticipated more or less friction and drawbacks due to the adjustment of conditions. After the experience of the first campaign relations are established and the future of such a factory is assured. During these five years most of the old factories which failed to develop conditions justifying their continuance have been removed and installed in other places. Such factories removed to new places, surrounded by new environments, fostered by known and established conditions favorable to their success, are now operating satisfactorily. So we may safely assert that the adjustment period, due to immature and impractical methods of installation, is about over.

Of the States in which crops are produced by rainfall the manufacture of beet sugar has been undertaken in six: Illinois, Michigan, Minnesota, New York, Ohio, and Wisconsin. The States in which beets are grown mostly by rainfall assisted by irrigation to some extent in some of the beet districts are California, Nebraska, Oregon, and Washington—four in number. The States in which sugar beets are produced largely through irrigation supplemented by limited rainfall are Colorado, Idaho, Montana, and Utah, and one Territory, Arizona, will enter this class in 1906, making five.

It can be readily seen from the above that rainfall plays an important part in beet-sugar production. The number of factories located

in the eleven States having districts growing sugar-beets with moisture supplied mostly or exclusively by rainfall is forty-six. The total daily capacity of such factories is 31,400 tons. The number of factories in the five States growing beets where irrigation predominates is twenty-six, and their total capacity aggregates 21,200 tons.

It will be seen from the above that the number of factories and their aggregate daily capacity for production is not so great under irrigation as under rainfall. In recent years, however, the progress of the beet-sugar industry in the irrigated districts has proceeded much more rapidly and satisfactorily. This is due to the undeveloped condition of the West. It is seeking and fostering new industries. At the same time the more fully developed conditions of the East have made it necessary for the beet-sugar industry to fight for a position in a well-established system of agricultural production.

In establishing a sugar factory in the East it is almost impossible for the company to procure a large body of land of its own, at least at prices which will make the investment profitable. It has been found that it is desirable for a sugar-manufacturing company to own a certain amount of farming land, especially in the early factory work. Such land can be managed to furnish the factory a larger supply of beets from the start. The methods employed in the cultivation of the beets are also more directly under the control of the factory management. Out West a body of land can be secured more readily and at a more reasonable figure. With the establishment of the sugar factory the value of the land increases very fast. This, itself, offers a large inducement for the establishment of the factory. It takes about a year to build and equip a sugar factory. In that time an absolutely new district can be, and often is, entirely settled. With the aid of a sugar factory the settlement of such a district proceeds somewhat in a similar way to the building of what is known as a "knockdown" house—you simply bring it on the ground ready-made, put the pieces together, the whole thing is complete. The industrial growth of the community, in time and manner of development, is quite similar to that of the factory. A new district may be selected for the establishment of a sugar factory. With its foundation starts those of a town and the homes of the farming population. Roads are opened up, ditches are constructed, lands are plowed up, beets are planted, railroad facilities are introduced, and possibly trolley lines and rural free delivery. When the smoke from the furnaces pours out of the chimneys the following fall, it rolls over a well settled, improved, and prosperous community, all built and installed within the time of installation of the sugar factory. Of course, factories are more commonly located in communities already settled to a certain extent, but their establishment is always followed by marked improvements.

Prospects for further development of the industry appear very encouraging at the present time. At this time there is considerable discussion and agitation going on throughout the country in regard to the establishment of new factories. Not only is the number of new districts under investigation quite large, but there is a number of places where factories are actually building and several others where negotiations are in progress with prospects of favorable results in the near future.

#### ARIZONA.

PHOENIX.—Different valleys in the Territory of Arizona having ditches for irrigation or developed water resources for this purpose have been under investigation for some time to ascertain conditions for growing sugar beets and manufacturing sugar. So far as natural conditions are concerned the whole question hinges upon irrigation development. This investigation and agitation resulted in the formation of a beet-sugar manufacturing company at Phoenix, capitalized largely from eastern sources.

The location is at a small place called Glendale, about 8 miles from Phoenix. The daily capacity of the new plant is 800 tons of beets daily. During 1903 considerable work was done on this plant, the construction of the building being nearly completed. Also a considerable part of the machinery was installed. Owing to some financial difficulties, work was finally suspended and the plant passed into the hands of a receiver. Recently matters in dispute were settled and a new company organized. Contracts were made with the farmers for a supply of beets. The factory is being completed and will be ready for operation in 1906. Its first campaign will begin some time early in May. At this place beets are planted earlier than at any other place in the country. Winter rains begin along in the early part of January. Advantage is taken of this for germinating and starting the crop. Although the climate is hot, the cool evenings, the naturally favorable soil conditions, and continuous sunshine during the growing period make it possible to grow beets of superior quality throughout the valleys of Arizona.

The particular thing that inspired the building of this plant was the installation by the Government under the reclamation act of a large irrigation reservoir and ditches accommodating a large body of land. This was one of the first established by the Government, is a magnificent piece of work, and will be the first of the Government reservoirs completed in the United States.



## CALIFORNIA.

California was the first State in the Union to go into the beet-sugar industry extensively. In the early nineties the wave of financial depression existing throughout the country affected the producers on the Pacific coast probably more seriously than others farther east and better located in regard to markets. The time required for shipping crude products from California to the East is especially discouraging to producers of perishable crops. It was but natural that California should begin to investigate carefully the methods for diversifying agricultural production. This led to the establishment of canneries, dairies, creameries, poultry farms, and sugar factories. The original purpose was to grow sugar beets with natural moisture. Sugar production was quite spasmodic at first. Unfortunately, in the early history of sugar production in California the State experienced a long period of drought, and as the sugar industry was one of the least understood it was the most affected. The results have been favorable to the industry rather than harmful. They caused more conservative action in factory building and inspired more energy in developing conditions to meet the demands of the factories already installed. The seasonal conditions of valleys were studied to find the best time for planting beets. The development of water supply for irrigation also became a burning question. This led to the development of artesian wells, some of them flowing and others requiring the use of pumps.

During the past few years considerable agitation and negotiation has occurred at different points touching the installation of new factories. The following places have been under consideration:

CHICO.—Chico is located in the Sacramento Valley in Butte County, about 100 miles north of San Francisco. This valley has been investigated throughout its length and breadth for some time to ascertain its adaptation to the beet-sugar industry. Conditions favorable for this purpose have been pretty thoroughly demonstrated. In my last report I noted the strong probability that Colusa would secure a sugar factory, but this agitation culminated in a decision to locate a large factory at Chico, near Colusa. Recently the Alta Beet Sugar Company, with a capitalization of \$2,000,000, decided to build a plant of 1,000 tons daily capacity here. The operating company has purchased 8,500 acres of land. The factory is to be located about 12 or 14 miles from Chico in a new district. Its location is to be known as Hamilton. Engineers are now laying out the site. A town will be started with 150 new houses. The lands will be put under cultivation, and everything will be in readiness for the campaign of 1906. Beets will be grown by irrigation. The company has a ditch of its own extending about 7 miles, the water coming from the Sacramento River.



The Sacramento Valley has been under investigation during this season and last. Considerable agitation has occurred throughout its length. This was induced by the united effort of the business organization representing all the leading towns in the valley. In order to get some authentic record of the results of beet growing, I have procured in this valley a statement showing results at Colusa in 1896. The beets tested were grown by 84 farmers. They were of desirable size. The yield averaged about 17 tons to the acre. The beets averaged 15 per cent in sugar content and over 80 in coefficient of purity. Considering that these experiments were made by farmers, I regard this showing for Sacramento Valley as highly encouraging.

FRESNO.—This place has been under discussion to a considerable extent during the early part of this season. The chamber of commerce for the county appointed committees to solicit acreage from the farmers. A general interest was manifested. Agents of the Santa Fe Railroad took an active part in the discussion. Negotiations have been under headway for some time. Indications point to the location of a sugar factory at this point some time in the near future. It is one of the best-developed districts of California. Market gardening is carried on to a considerable extent; also the production of small fruits. It is especially noted as a grape center.

VISALIA.—A company known as the Los Angeles Sugar Company for some time exploited conditions in the Antelope Valley with a view to establishing one or more sugar factories. This company changed its name to the Pacific Sugar Company, contracted for 3,000 acres of beets, and is constructing a plant at Visalia with 350 tons' daily capacity. A part of the machinery composing the equipment of this plant comes from St. Louis Park, Minn. The company owns a site of 40 acres near the town, which is reached by the Southern Pacific Railroad and is accessible to the Santa Fe Railroad. The 1st day of January, 1905, the factory was about half completed and 90 per cent of the machinery on the ground. The plant will be in readiness for the campaign which begins about August, 1906.

In the vicinity it is estimated that 100,000 acres of good beet land can be found. Beet planting in the district begins about January 1, and can be continued up to April 1. Early beets are grown without irrigation; but the later plantings require it. The soil is a fine sandy loam, with a little tendency to alkali. Visalia is about 150 miles north of Los Angeles, in Tulare County.

Below is inserted a report from Prof. G. W. Shaw, College of Agriculture, Berkeley, Cal., showing the high quality of beets grown in the district tributary to this new factory:

Referring to your favor of the 19th instant, relative to the analysis of beets grown at Reedley in 1905, I beg to say that I analyzed two samples of beets brought to me by C. L. Sea-

graves, a representative of the Santa Fe Railroad, the results of said analysis being as follows:

No. 1. Brix, 24.037; sugar in juice, 21 per cent; apparent purity,  $87\frac{1}{2}$ ; average weight, 625 grams.

No. 2. Brix, 25.237; sugar in juice, 22.60; apparent purity, 85.8.

You will note that these beets are exceedingly high in both sugar and purity, and are of fair weight. As to the individuals who grew these beets I have no knowledge.

Yours, very truly,

G. W. SHAW.

#### COLORADO.

Throughout my reports for the last four or five years I have discussed pretty generally and thoroughly conditions adapted to the beet-sugar industry in this State. This industry has materially changed and helped the whole agricultural status of the State. Probably the changes are more noticeable in this State than in any other. This is due to the fact that, when started, Colorado's agricultural resources were practically in their infancy. For this reason results could be more readily ascertained. The sugar factories in Colorado are constantly under investigation by committees from neighboring States representing associations, chambers of commerce, farmers' organizations, and the like. It is quite likely that the industrial development of Colorado will be duplicated to some extent in neighboring commonwealths. This is already true of Idaho and to some extent of Montana, with strong probability that it may be even more fully realized in Wyoming. In Colorado new lands have been reclaimed and large modern plants installed. These have been improved from year to year and additional and supplemental facilities have been added. Though but a few years have intervened, one of the strongest of farmers' organizations in the State is that of the beet growers, with county associations from which a State organization is formed, holding annual meetings. Two new factories entered the campaign last year; others are building, and quite a number are in prospect.

BRUSH.—In earlier reports I discussed conditions around this place and called attention to the strong probability of the installation of a sugar factory. During the season of 1905 a factory was located here by the Great Western Sugar Company. The plant has 600 tons' daily capacity. The farmers in this vicinity are now experienced in sugar-beet production. For several seasons they have been growing beets for other factories. The factory now under construction will be in readiness for the campaign of 1906.

Brush is in the eastern part of Morgan County and the northeastern part of the State, and is located on the Burlington and Missouri River Railroad. Its farming lands are irrigated from the South Platte River. In anticipation of establishing a factory at this place the beet-sugar company secured the growing of 1,500 acres of beets there in 1905 and contracts covering 3,500 acres for 1906.

COLORADO SPRINGS.—For some time investigation has been made of Fountain Valley, lying southeast of Colorado Springs, distant about 15 miles. This district is well adapted naturally to beet production. Recently a tract of 30,000 acres was purchased. It is to be watered from two storage reservoirs covering about 400 acres each, 60 feet deep, and furnishing an abundant supply of water. The plan contemplates the erection of a sugar factory at Fountain, on the railroad, in the center of the district.

FORT MORGAN.—The Great Western Sugar Company has established a factory at this place with 600 tons daily capacity. Farmers in the district have been growing beets for two or three years for other factories in the vicinity belonging to the same company. The pioneer work of the industry has been done. Sugar-beet growing and the benefits of the industry are very well appreciated in the district. The industry starts off under conditions favorable to its success. The factory will be in readiness for the campaign of 1906. About 1,500 acres of beets were grown for the campaign this year. At the same time contracts were secured for 3,500 acres for 1906.

Fort Morgan is about 10 miles west from Brush, in the center of Morgan County, in the northeastern part of the State. The beet lands are irrigated from South Platte River. It is on the Burlington and Missouri River Railroad.

LAS ANIMAS.—Quite a large acreage of beets has been grown around this place for several years and shipped to Rocky Ford. Gradually this acreage has been increasing until conditions have been sufficiently developed to sustain a sugar factory. For some time business men and leading farmers in the vicinity of Las Animas have been agitating factory establishment. On two or three occasions it was quite definitely announced that the factory was assured. The owners of the one at Rocky Ford naturally feel an interest in the legitimate result of their development work. They have extended considerable encouragement to Las Animas. Recently it is announced that this company made a proposition to the Commercial Club of Las Animas that a 600-ton plant would be installed here provided contracts for 2,500 acres could be procured for 1906 and 5,000 for 1907. Committees have completed this work and it is announced that the American Beet Sugar Company will build a factory of 600 tons daily capacity in accordance with this proposition.

Las Animas is located in Benton County, in the southeastern part of the State, on the Santa Fe Railroad, about midway between Rocky Ford and Lamar, at each of which the American Beet Sugar Company already has a factory. Lands growing beets in this vicinity are irrigated from the Arkansas River.



I clip from the Denver Post, of January 19, 1906, the following:

A formal contract has been drawn between a committee and citizens of Las Animas and Frederick Weitzer, manager of the American Beet Sugar Company, whereby, in consideration of 2,500 acres of beets for the year 1906 and 5,000 acres for the years 1907, 1908, and 1909, to be grown in the vicinity of Las Animas, the American Beet Sugar Company agrees to construct a 600-ton beet-sugar factory here for the 1907 crop and to add a railroad spur from Las Animas east and west for a distance of about 10 miles each way. These spurs are to be connected with similar spurs built out of Lamar and Rocky Ford, thus forming a through line. All is to be completed by 1907. The American Beet Sugar Company is to provide a large bond to insure the construction of the road and fulfillment of its contract.

SWINK.—Plans and contracts have been made for a factory at Swink, which is located 5 miles east of Rocky Ford. It will accommodate a large beet-growing district north and east of that factory which has been growing beets more or less for it but not to the extent of its capabilities on account of the difficulty of delivery. The factory located at Swink is to have 1,000 tons daily capacity. It is established by the same interests owning the factory at Holly.

A railroad is to be built from Holly to Swink Station, a distance of 85 miles, in order to accommodate its work and its beet-growing district. Contracts for 11,000 acres of beets have been signed. This guarantees the plant an abundant supply of beets during its first campaign. It is to be completed in time to work up the 1906 crop. As in other beet-growing districts in the southern part of the State, water for irrigation comes from the Arkansas River.

OTHER PLACES.—Colorado has proved a very fertile field for investigation and extension of the beet-sugar industry. In districts throughout the State located in fertile valleys whose agricultural resources have been investigated, if possessing sufficient area to maintain a sugar factory, its installation is looked upon as the one thing necessary. Results repeated so many different times at different places point to sugar production as the main feature in all plans for settling and improving a district. Farmers and business men are drawn together in an organized attempt to unite all interests in a move to secure a sugar factory. Pledges are secured from the farmers covering sufficient beet-growing acreage to sustain a factory. Negotiations and agitation proceed to the accomplishment of this end. In most of these places beets have been grown for factories at other places and the farmers informed regarding the conditions and requirements of beet culture. At quite a number of places in the State such campaigns are now being conducted. Among those often and favorably considered, in addition to those mentioned, are Julesburg, Delta, Montrose, Durango, Olathe, Glenwood, Erie, Boulder, and Pueblo.



## IDAHO.

Idaho is one of the States recently developing considerable interest in beet-sugar production. For some time many of her valleys available for intensive agricultural development have been under investigation. This investigation culminated in the last three years in the establishment of four large factories. Beets grown in the State are of an unusually high quality, and the yields are good. As fast as development shall proceed and conditions warrant, several other factories will be installed in the State. A factory is now building at Nampa with 600 tons capacity. This belongs to the Idaho Sugar Company, the same as the ones at Sugar, Idaho Falls, and Blackfoot.

PAYETTE.—Contracts were secured at this place for 3,500 acres of beets for the 600-ton factory to be built at this place by the Idaho Sugar Company. This factory was to be in operation for the campaign of 1906. Afterwards arrangements were made with the company to deliver the beets grown for 1906 to the factory at Nampa, the sugar company entering into a contract and bond to build a factory at Payette in 1906 to operate in the campaign of 1907.

Several other places are under serious discussion as regards the location of a factory.

## ILLINOIS.

From time to time we hear considerable discussion about the establishment of factories in the lake region of Illinois, especially in the vicinity of Chicago. This agitation is induced by the superior commercial facilities offered for industries of all kind in that section of the State. By thorough experimentation it has been found that the soil in the northern part of the State is well adapted to beet production. During the past season a factory of 400 tons daily capacity was installed at Riverdale. Plans are maturing for the introduction of one or two others in the vicinity of Chicago.

GENESEO.—This town is located on the Rock Island Railroad about 20 miles east from Davenport and on the Mississippi River. It is in one of the old, well-established farming districts of the State. The soil yields 60 to 100 bushels of corn per acre and other things accordingly. Most of the corn produced is fed to stock in the community. Good farm lands are generally valued at \$150 per acre. This district took up the agitation for establishing a beet-sugar industry. Public meetings were held, contracts were secured for a large acreage, negotiations were entered into with capitalists, promoters, and others with a view to capitalizing the project. It was finally concluded by all those interested that the season had progressed too far to plant beets and build a factory for the campaign of 1905. It was decided to plant a number of plats to sugar beets throughout the neighborhood with a view to more nearly ascertaining natural conditions. As in nearly all

other experiments of the kind with no directing head insisting on details, the results of these experiments were generally unsatisfactory. This is an old story. Such experiments indicate nothing. I have seen so much of this reckless work of experimentation, which means nothing but disappointment unless followed out in the most careful manner, that I give the results but little weight as evidence. It is proposed to conduct further experiments at this place to ascertain more definitely natural conditions and keep in touch with outside interests tending to further the enterprise. To the investigation of this place I gave considerable time and attention. I am thoroughly convinced that the farming district would eventually prove it a superb location for a beet-sugar factory. The company would have to depend entirely upon sugar making, as there could be no profit from investment in land for a rise in value.

#### IOWA.

Considerable agitation tending to the establishment of sugar factories occurred in the State during the year. By experimentation, favorable conditions have been ascertained. As a rule the beets grown are of sufficiently good quality to meet the requirements of a sugar factory. In growing sugar beets it especially excels in two things: (1) Its regularity of crop production; (2) its yield. The real difficulty in promoting the beet-sugar industry in Iowa and many other States in the Mississippi Valley and farther east arises from the farmers' disinclination to grow the crop. This feeling in Iowa would probably change with the installation of a sugar factory. Good yields would overcome the farmers' inertia. On account of the adaptability of the soil of the State to sugar-beet production, its railroad facilities, and proximity to good markets, I regard it as very favorable territory for sugar production, and I find that some of the leading beet-sugar producers of the country entertain the same views.

The places now under discussion and investigation are Columbus Junction, Des Moines, Muscatine, Waterloo, and Waverly. During 1905 considerable agitation and discussion occurred at these places.

#### KANSAS.

Conditions favorable to beet-sugar production have been under investigation for several years in the eastern half of Kansas, or that portion usually considered within the corn belt. Considerable interest has been evolved at times at different places, but none of the prospects have materialized into actual sugar factories. The operations of the factories in eastern Colorado along the Arkansas River have stirred up considerable interest in the western part of Kansas. Conditions here are somewhat similar to those in eastern Colorado. The rainfall is light, but for the last two years beets of good quality and

yield have been grown for the Colorado factories. In order to encourage this industry the legislature of the State passed a law five years ago offering a bounty of \$1 per ton for all beets grown in the State. This has had a tendency to stimulate the industry in the extreme western part of the State, where irrigation from the Arkansas River is developing to a considerable extent, and notably in the vicinity of Lakin and Garden City. This is also true around Arkansas City, at a point near the southern boundary, where the river goes out of the State. The interest developed in the western portion is largely confined to Finney and Kearney counties, of which Garden City and Lakin are the county seats, the Arkansas River passing through both counties from west to east. The American Beet Sugar Company, having factories at Rocky Ford and Lamar, has developed this territory for growing sugar beets for those factories.

GARDEN CITY.—It has been announced for some time that Colorado sugar-producing interests would install a factory at this place as soon as irrigation facilities were sufficiently developed and beet production should develop to the point of sustaining a factory. During this season some of the leading beet-sugar capitalists of Colorado expended a large sum for land near Garden City. They also bought up, improved, and extended irrigating ditches, reinforcing them with new pumping plants, and invested considerable money in several enterprises incidental to sugar production. Finally, plans were adopted for erecting a sugar factory at this point of 600 tons daily capacity. Material was purchased and contracts let for the installation of this concern for the campaign of 1906. The United States Government has established at this point a pumping irrigation plant, which will materially aid in the development of the district. Farmers are to receive a flat price of \$5 per ton for beets delivered by wagon or loaded on cars at station.

As indicating the purpose of those investing in sugar factories, lands, etc., near Garden City, I clip from the Kansas City Journal of December 20, 1905, the following:

"We have already planted \$500,000 in Kansas land near Garden City," said Mr. Hamlin, "and will put another \$1,000,000 in within the next twelve months. We hope to have the sugar factory at Garden City completed in time for next year's beet crop. The company contemplates the construction of four more sugar factories in the valley as the industry develops. Most of the beets next year will be raised on bottom land, but the uplands will be under irrigation within a couple of years. Experts say that the water can be conserved better where ground is irrigated and that the soil is well adapted for the culture of sugar beets. Our company will not depend in any way on the Government irrigation plant at Garden City. We have a plant of our own; in fact, we own three ditches out there now and an interest in the fourth one. We will irrigate on our own hook. We expect to put in a big pumping plant at Dodge City for one of the ditches. We are contracting now with farmers for sugar beets for next year. We expect to get at least 40,000 tons from the country around Garden City next year. This will be a good start."

In order to ascertain the facts with reference to this project, I solicited and obtained the following special report from Chas. A.



Loucks, Lakin, Kans. He was prominent as a member of the local committee to encourage the establishment of this industry in the district:

DEAR SIR: The United States Sugar and Land Company are at present erecting a 600-ton factory at Garden City, Kans., the contract for the building having been let, and surveyors are now at work on the site. These people have purchased, as nearly as I can ascertain, some 40,000 acres of land in the Arkansas Valley, lying between Lakin and the town of Garden City. They have purchased two systems of canals in this county, and are making extensive improvements. They give us their assurance that there will be several other factories erected in the valley just as fast as a sufficient amount of beets is grown to warrant it.

Yours, very truly,

C. A. LOUCKS.

OTHER PLACES.—It is announced by those interested in establishing the plant at Garden City that four other factories will be built in the vicinity of the Arkansas River in western Kansas as soon as developed conditions shall warrant. The town of Lakin has grown beets to a considerable extent and has demonstrated conditions quite favorable to this industry. It is likely that this will be the seat of a sugar factory in 1907, and several others will follow in the near future in this district. Deerfield is another place where a factory will very likely be installed.

#### MINNESOTA.

During the season a large number of places in different parts of the State of Minnesota have been investigated to ascertain conditions adapted to the beet-sugar industry. All these have been found quite favorable for the purpose. A factory has been in operation at St. Louis Park near Minneapolis for a number of years. For this factory beets have been grown in an area extending from it each way for 100 miles. This has disclosed in a practical way conditions for producing sugar beets in the southeastern half of the State. During the season the factory at St. Louis Park was burned, resulting in a total loss. This stimulated the endeavor of other places to secure the site of its rebuilding. Considerable discussion and agitation have occurred in the southeastern part of the State during the year. For many reasons this district offers excellent opportunities for the establishment of two or three sugar factories. The one that has been operated here has done the pioneer work and has built up and established conditions favorable to the industry. It will not be necessary for a new factory to go over the same ground. The management of the old factory accomplished this work at considerable trouble and expense. To secure sufficient beets it was necessary to take contracts at places too far distant. Originally considerable beets were grown for this factory in Iowa at points 250 miles distant. Gradually the factory was able to recede from these distant areas as it built up a supporting area of beet growing nearer home. Beet cropping has grown very much in favor of late, and the factory builder who succeeds in obtaining a



location in this district will fall heir to the benefits of this work so necessary to the successful operation of every sugar factory.

Among the places discussed this season with a view to installing the industry in the State are the following:

**CHASKA.**—Chaska is one of the places whose business men and farmers have made strenuous efforts during the season to interest capital in the establishment of a sugar factory, with the result that the Carver County Sugar Company was organized. This place is well located to receive the benefit of the development work of the factory at St. Louis Park, recently burned, covering the last six years. It is 20 miles south of the location of this original factory and more nearly in the center of the district that has been growing beets for it. It is well accommodated with railroads connecting with other railroads which thoroughly cover the farming district for 50 miles in every direction. This is an old, well-established, and well-developed farming district. Considering the work that has been accomplished in beet growing in this part of the State and the favor in which it is held by farmers generally, there is every reason to believe that this factory will be a success from the start.

**FARIBAULT.**—The Commercial Club at this place has made energetic endeavors to secure the location of a sugar factory at this point. Committees were appointed to solicit acreage from farmers, the contracts being made to cover five years. These efforts were inspired by negotiations with prominent sugar-producing interests of Michigan. The acreage was procured, but for some reason the first project failed to materialize. Following this, another offer of capitalization was made on conditions that sufficient acreage be pledged and a \$20,000 bonus granted. The plans provide for a 600-ton plant.

Faribault is situated in Rice County, in the southeastern part of the State. It is in a splendid agricultural district. It produces corn, potatoes, small grains, and live stock. The farming district has produced sugar beets to greater or less extent for the factory at Minneapolis. It has railroads radiating from it through its farming areas in five different directions. It is well located and would no doubt sustain the beet-sugar industry admirably. Prospects appear very encouraging for the location of a sugar factory at this place to be in operation in 1906.

**GLENCOE.**—This place has been under consideration by several parties during 1905. General conditions for growing beets and producing sugar are conceded to be favorable. A sugar factory is possible at this point some time in the near future.

## MICHIGAN.

Michigan has more sugar factories than any other State in the Union. Factory building proceeded faster than conditions would warrant; that is to say, some places were congested beyond the capacity of farming districts to supply the beets. Other factories were placed in districts where the farmers have shown a disinclination to grow beets. These errors have been corrected by the removal of some of the plants to other places better able or more willing to supply their wants. In all 24 factories have been built. During this year a factory of 600 tons' capacity was installed at Blissfield, near the southeastern corner of the State. It receives considerable beets grown in Ohio. Beet growing has become more or less popular in the northwestern part of that State.

CHARLEVOIX.—Three years ago a company started to erect a factory of 350 tons capacity in this place. After expending about \$250,000 the management experienced some financial difficulties, and work was stopped. The building was nearly completed, and considerable of the machinery was installed. This property passed into the hands of a new company during the present season. It is announced that this company will complete the plant, secure contracts for growing beets, and operate in the campaign of 1906. Beets have been grown in the vicinity of this place to a considerable extent from the year in which construction of this factory began. These beets have been delivered to other factories in the State. Their production has contributed to the general education of the farming district in the methods and benefits pertaining to the crop.

## MONTANA.

Like Wyoming and Idaho this State has many natural resources for sustaining the beet-sugar industry; it is new and undeveloped and prepared to embrace at once any opportunity to forward its industrial growth. It is lacking in transportation and irrigation development. It has several large water courses draining the mountain areas. These gather the water from snow and rain and distribute large volumes to the valleys. The opportunities for storage presented by these water courses and mountains is attracting the attention of the Government Reclamation Service. The State's general conditions as regards the sugar industry are quite similar to those of Idaho, Wyoming, and Colorado. The soil also is similar in character.

There are plans on foot to install beet-sugar factories in a number of valleys in Montana. These have been maturing during the last few years. They necessarily move slowly from the fact that they involve so much other improvement necessary to the sugar industry, such as extension of railroads, irrigating ditches, settlements, etc.

**BILLINGS.**—A factory of 1,200 tons capacity is building at Billings. This is in the southern part of the State, about midway between the eastern and western boundaries of the State, on the Northern Pacific Railroad. The agricultural lands are watered from Yellowstone River. A new ditch has just been completed covering a large body of new cultivable lands. The district is considerably advanced for a new section. Prospects for the future of the sugar factory appear bright.

**BOZEMAN.**—Bozeman is the seat of the agricultural college and experiment station. The district has been on the eve of locating a factory for some time. This district, known as Gallatin Valley, has especially been under investigation by experienced parties from Utah, who look upon it with much favor. Considerable rivalry has developed between this place and two other favorable points, known as Central Park and Manhattan.

Contracts with the farmers covering sufficient acreage to sustain a factory have been procured. These extend over a period of three years. Upon these as a basis local interests are endeavoring to negotiate with capitalists and are receiving considerable encouragement.

**HAMILTON.**—This place is located in Bitter Root Valley. Considerable agitation has been kept up for some time under the direction of the business men's club at that point. It is now arranging contracts to procure 5,000 acres as the result of a proposition from capitalists to build a factory at this point if this acreage can be procured. Local capital has been pledged to the extent of \$200,000. The plan under contemplation provides for a 600-ton plant. The agricultural conditions for growing sugar beets throughout the district have been tested in many ways. These are found quite favorable for the industry. The results of investigations made by the experiment station at Bozeman and the sugar factories of Utah and Colorado are especially favorable to sugar production.

**KALISPELL.**—This place is located in the Flathead Valley. Those locally interested have been attracted to the beet-sugar industry, and the district has received considerable attention from persons engaged in beet-sugar production. Both the companies operating in Utah have investigated conditions around this place quite carefully, and both have been favorably impressed. It is currently reported that both these companies have made propositions to build factories at this point provided sufficient acreage is placed under contract and at their disposal.

**OTHER PLACES.**—At several other places the people have gone into the subject more or less definitely with prospects somewhat encouraging. Among them are to be noted Chinook, Laurel, Missoula, Dillon, and Great Falls. The latter place is in the vicinity of what is known as the Sun River Government project for irrigation which, with the



Conrad Canals already operating, gives the district sufficient water to irrigate a large body of land. This place has been offered a factory as soon as it is in a condition to produce 5,000 acres of beets.

#### NEBRASKA

For several years three plants have been operated in the eastern portion of Nebraska, where beets are grown under rain conditions. While there has been more or less discussion with reference to the establishment of other factories in the eastern part of the State, none of it has apparently been serious enough to produce results. As in Kansas, new projects appear to seek the drier western section of the State, little developed but possessing irrigation resources and capable of considerable intensive agriculture if water is applied. The factories at both Leavitt and Grand Island at present receive more beets from the western part of the State than from their immediate vicinities.

NORFOLK.—Considerable discussion and agitation have occurred during the past season with reference to Norfolk. When the American Beet Sugar Company removed its factory from this place to Lamar, the building and 240 acres of land were returned to the citizens who gave it for this particular purpose. Those locally interested are anxious to see the sugar industry reinstalled. In the absence of the factory the people of this place have learned to appreciate the great benefits they have lost. More beets were grown in the district around Norfolk during this season than usual. The beets were delivered to the factory at Leavitt, a considerable distance away.

Among others who have been brought to a realization of losses sustained in the removal of a factory is the management of the Union Pacific Railroad. This company has united its influence with that of business men and leading farmers of the district to induce some other company to equip the building with sugar-manufacturing machinery and start sugar production again, offering as an inducement the plant as it stands for this purpose. This proposition has been under consideration by several parties interested in beet-sugar production. The inducements are certainly very encouraging. The fact that this locality has been under development so long and that the old factory has accomplished so much in developing resources of beet-sugar production at this point should receive great consideration. The further fact that the farming community and business element have been able to measure the benefits of such an institution by being deprived of them for a time will be another strong feature in its favor. I am convinced that if the sugar factory should start in operation again at this place it would realize an appreciation on the part of the public similar to that realized by the plant at Grand Junction, Colo., after it had closed down for a couple of years. This is an expensive kind of schooling, but very effective.



**NORTH PLATTE.**—The district around North Platte has been worked up until annually it produces for factories farther east in the State about 4,000 acres of beets. This amount of land under normal conditions would furnish Grand Island more beets than it ever secured for a single campaign, or would give the factory at Leavitt an ordinary campaign.

It was announced in 1904 that the Standard Beet-Sugar Company of Leavitt had proposed to business and farming interests of North Platte that, if a large acreage of beets were grown for the factory at Leavitt during the years of 1904 and 1905 and contracts with farmers procured for 6,000 acres for three years, beginning with 1906, a factory would be constructed at this place by the people interested in that company. These conditions have been complied with, and it is announced that the Standard Beet Sugar Company has arranged its plans and ordered machinery to establish a factory at this place to be ready for the campaign of 1906. The new company is to be known as the Overland Sugar Company, to be located at North Platte, or some place near, in Lincoln County. All these lands in this district under irrigation have given excellent results in beet growing for several years both in quality and yield of beets. Water for irrigation here comes from the Platte River.

In order to obtain as correct information as possible with reference to the establishment of a beet-sugar factory at this place in 1906, I wrote Mr. James Scillee, of North Platte, who makes report with reference to the new factory and prevalent conditions during the season as follows:

Mr. Leavitt expects to build a 650-ton factory in the vicinity of North Platte this spring. He expects to have it ready to work up the 1906 crop. There are 8,000 acres of beets signed up for three years for the new factory. We have not had a very successful year this year on account of adverse weather conditions, which has cut the tonnage some and also caused the beets to be lower in sugar.

Our acreage has largely increased, and I think we will have 12,000 acres in this valley the coming year. We have grown 1,000 acres in Scotts Bluff County this year, which have made an average of 15 tons per acre, some of them yielding as much as 28 tons per acre.

On the whole, the industry is in a very healthy condition in this territory.

**OTHER PLACES.**—There are several other places out in western Nebraska having conditions quite similar to those at North Platte, that have been considered quite seriously with a view to establishing sugar factories. As at North Platte, beets have been grown in the vicinity of these places for some time, conditions have been thoroughly tested, and the benefit of beet crops are thoroughly appreciated by all concerned. Scarcity of labor and the undeveloped condition of the districts are the main drawbacks. Sutherland, in the western part of Lincoln county, in which North Platte is located, has agricultural lands irrigated from the Platte River. McCook, the county seat of Red Willow county, and Culbertson, in the eastern part of Hitchcock

county, are places around which considerable beets are grown annually. These beets are of high quality, and, with sufficient water, the land returns a good yield and beets of high sugar content and purity. Irrigation in both these districts is conducted from the Republican River.

#### NEW MEXICO.

In the arid section that has been investigated for conditions favorable to the beet-sugar industry is the Territory of New Mexico. At different times several places have been under investigation with the result that natural conditions are found favorable wherever sufficient water can be secured. A small plant some years ago was built at Carlsbad on the Pecos River. This operated for two or three years, and then was discontinued for a year or two until a more satisfactory area of land devoted to beet growing could be developed. During this interval the factory burned down. Among other drawbacks to its success, it was too small. Also with the facilities for irrigation in use at that time under the heavy evaporation of a dry season, the waters were too saline for good results with the beet crop.

About 75 miles north of this place is Roswell, in the center of a very productive fruit district. Irrigation here is largely from artesian wells and conditions are all that could be desired for producing sugar beets. The business interests of this place during this season received a proposition from outside parties interested in sugar production, offering to build a plant of 1,000 tons daily capacity provided contracts could be secured for a sufficient acreage to grow the sugar beets. Experiments have been conducted during the year to test conditions and the matter is under consideration with strong possibilities that a plant will be erected here in the near future.

#### OHIO.

Many places in the northern part of the State have been investigated with a view to building sugar factories. Conditions agriculturally and commercially have been found generally favorable. The State has maintained one factory at Fremont for several years. Like other factories established in the older and more settled portions of the country where productive and commercial interests are well established and developed, the Fremont factory had a hard struggle at first to maintain itself. Gradually it has built up its resources until it is one of the most successful concerns of the kind in the United States. To secure sufficient beets it necessarily had to reach out to a considerable distance from its base, gradually contracting its beet area as beet growing increased nearer home. Its beet district in the northwestern corner of the State developed more rapidly than in other parts. This was caused by the proximity of two or three factories in Michigan for which beets were grown as well as for the one at Fremont.

DEFIANCE.—The agricultural district of which Defiance is the center grew beets to a considerable extent for these other factories. For some time it has been apparent that beets could be grown nearer home for the factory at Fremont. This has led the management of the Continental Beet Sugar Company of Fremont to propose the installation of a factory at Defiance. It made a proposition to those locally interested at this place to build a 500-ton plant provided contracts for 5,000 acres of beets could be secured. Business clubs and organizations of the place took the matter under consideration, committees from these procured the acreage, and the company has given assurance that it will build a plant in time for the campaign of 1906.

TOLEDO.—There has been more or less discussion and agitation in behalf of the establishment of a beet-sugar factory at this place. In order to obtain facts, I wrote the secretary of the Business Men's Chamber of Commerce Company and received the following reply.

DEAR SIR: Your letter of December 13 to Mr. W. H. Tucker, our postmaster, has been referred to me with instructions to give you as much data as we may have in our possession on the beet-sugar business. There has been some talk of locating and installing a beet-sugar plant in the vicinity, but the plans have not matured sufficiently to give you a definite idea as to what are the possibilities in that line.

It may be interesting to you to receive some information on tests that were made some three or four years ago in three of the counties adjacent to Toledo: Beets grown in Wood County averaged 14 per cent sugar, and 79.1 purity; in Lucas County, 12.7 sugar, 76.4 purity; in Henry County, 15.2 per cent sugar, 82.6 purity. At that time 44 specimens were tested and only 3 went below 10 per cent sugar, while some were above 20 per cent sugar and 2 above 90 in purity. The 3 that went below 10 per cent sugar in Lucas County reduced the average to 12.8 per cent and the purity to 76.4.

The section around Toledo is very well adapted to beet growing, owing to the great area of marsh land which can be reclaimed by dykes.

#### OKLAHOMA.

At various times consideration has been given to the beet-sugar industry by various commercial clubs and organizations representing different sections of Oklahoma. Most of the plans proposed have been of a tentative character, awaiting the results of experiments. During this season Shawnee had under consideration two different propositions contemplating the building of a 500-ton beet-sugar plant. Both of these received active consideration and aroused public interest. At the present time negotiations are under way with no definite conclusions in sight.

Among others interested in establishing the beet-sugar industry in this place is the Western American Colonization Company, which has given the subject considerable attention and investigation.



## OREGON.

Oregon has had one factory for some time. During the past season the extension of the beet-sugar industry in the State has been under consideration at a number of points. Some of these places grow beets and other crops by rainfall, as in the La Grande district, and some have irrigation or are developing systems for the purpose of irrigation. Lack of railroads has been the great retarding factor in beet-sugar development in this State. Nearly all the projects under contemplation have in view building railroad extensions in order to accommodate the establishment of the beet-sugar industry.

BEND.—This place has been under consideration by capitalists and others interested in the beet-sugar industry through the instigation of the Dechutes Irrigation Company. About 8,000 acres of land has been secured for this purpose, and the same has been tested experimentally during the past year.

I am of the opinion that this area is particularly adapted to the growing of sugar beets and all other root crops; but at present the lands are from 70 to 100 miles from railroad and have a limited population. These drawbacks make the erection of a beet-sugar factory an impossibility at the present.

ONTARIO.—The citizens of this place had under consideration during the season a proposition for establishing at that place a 500-ton plant.

ARCADIA.—The Utah Sugar Company is investigating conditions here, and considerable interest has been developed with reference to establishing a plant at this place. The district is rather well settled and developed agriculturally, and possesses many naturally favorable conditions.

## SOUTH DAKOTA.

On several occasions different communities in South Dakota have considered the establishment of beet-sugar factories. This State through its experiment station has carried on extensive well-directed experiments in growing beets. The existence of favorable conditions has been well established around such places as Watertown, Sioux Falls, Brookings, Mitchell, and Aberdeen. All of these places have at different times negotiated with capitalists for the purpose of installing beet-sugar factories. Under the conditions and environments of each beets would be grown by rainfall. During the season consideration of the beet-sugar industry became quite spirited in Belle Fourche. The agitation at this place was occasioned by the improvement of the Belle Fourche irrigation ditches, under the direction of the United States Reclamation Bureau. This irrigation system will recover and bring into use a large resourceful tract of land. It is the first irrigated section to come under consideration in South Dakota with a view to pro-



ducing sugar. Plans for this enterprise are developing with the construction of the irrigation system. Enough has been established to indicate a strong probability of a factory being built at this place in the near future.

#### UTAH.

The history of sugar production in Utah has shown a gradual and uniform development. It was the third State in the Union to produce sugar from beets. The first factory was established at Lehi in 1891 of 350 tons daily capacity. As the work of producing sugar beets became more familiar to the growers, and the territory producing them was extended, additional capacity was added to the plant. This was accomplished by means of slicing stations established in different valleys, in order to accommodate the growers. The capacity of this plant has been increased in this way to 1,200 tons daily, and it now has slicing stations at Springville, Spanish Fork, and Provo, each with a capacity for slicing 350 tons per day. Generally two of the stations and the plant work at the same time. The plant was not able to keep up with the progress of beet growing in this way, and it became necessary for it to install an additional factory at Garland, up in the southern end of the Bear River Valley. What has been true of this plant in developing its beet-growing area and capacity for sugar production is also true of the Amalgamated Sugar Company, which built its first plant at Ogden, Utah, and a later one at Logan. It has already largely increased the capacity of these two plants, and during the past season it built another one at Lewiston, in the northern part of the State. The factory capacity has simply expanded with the development of beet production. Each of these companies is considering the further extension of the beet-sugar industry in the State.

MORONI.—The Utah Sugar Company at Lehi has been receiving a large portion of its beets from San Pete and Sevier counties some 50 or 60 miles southwest of its location. Sugar-beet production has grown to such an extent in this district that the growers have been demanding the construction of a sugar factory to accommodate them. Negotiations have been carried on with others outside the Utah Sugar Company. Considerable rivalry has developed between the farmers in the two counties as to the location for the proposed factory. During the season the Utah Sugar Company finally adjusted the matter with a proposition to locate a factory under certain conditions in San Pete County, the Sevier County growers to deliver their beets to this factory during the campaign of 1906. The conditions were that the farmers were to bind themselves to grow a certain amount of beets for the factory and furnish a site and the usual requirements. Under the terms of this proposition a second factory is to be built in Sevier County in 1907. These plants are to have a capacity of 500 tons each.

OTHER PLACES.—Sugar beets are grown now quite generally throughout the cultivated parts of Utah. In other places the installation of factories has been under consideration. Conditions have been well demonstrated through the actual work of growing beets for considerable periods.

#### WASHINGTON.

Washington has had one factory manufacturing sugar from beets for eight years. For this plant beets are grown under natural moisture conditions.

Further extensions of the beet-sugar industry will probably occur in districts under irrigation. There are several places in the State that have been thoroughly investigated with the result that conditions have been found most favorable. As a rule, these depend upon irrigation. Beets grown in the State are found to be of high quality. It has already developed the largest beet-seed-producing industry. The extension of the sugar industry in the near future in the State, as shown by present indications, will probably occur at the following places:

ELLENSBURG.—At this place considerable interest has been aroused during the season. It has had under consideration the establishment of a sugar factory of 600 tons daily capacity. The Northern Pacific Railroad runs through this place and has done considerable to encourage the proposition. In the vicinity there is an excellent body of land adapted to growing sugar beets of good quality and quantity. Six thousand acres of land under contract is required. This has been secured, and \$200,000 local capital subscribed. In order to encourage beet growing, business men and leading farmers organized companies of sugar-beet growers, leasing tracts of land of 150 to 1,000 acres. Ellensburg is situated in Kittitas Valley in the county of the same name.

NORTH YAKIMA.—In the vicinity of North Yakima has been developed an area of 75,000 acres of excellent land. For several years beets have been grown in this vicinity experimentally. The yield is good and the quality high. There have been several projects for establishing beet-sugar plants at this place. Through the agitation growing out of these, conditions have been pretty thoroughly investigated. During the season two of these were under consideration with indications that two plants of 1,000 tons each would be built. North Yakima is in Yakima County, in the southern central part of the State. Lands are irrigated with water from the Yakima River. In order to get definite information touching the erection of a plant, I wrote to Mr. Alex. Miller, of North Yakima, who has been active in encouraging the enterprise, and received his report as follows:

DEAR SIR: In reply to your favor will say that the parties that were going to put in a sugar factory postponed final action, owing to their being unable to secure acreage enough,

because the farmers here make much money out of their land in other crops, as they always receive large yields under irrigation, which is the principal farming method in Yakima Valley. We expect in time that beet growing will be taken up.

#### WISCONSIN.

For several years Wisconsin has been producing sugar from beets. Its first factory was located at Menomonee Falls. This concern has been very successful in demonstrating conditions adapted to the beet-sugar industry in the various parts of the State. The factory has always secured enough beets to insure a long campaign. Last year two factories were constructed, one at Janesville and the other at Chippewa Falls. For new plants the results of both have been satisfactory. The operation of these two plants has tended to assist the one at Menomonee Falls in the general upbuilding of the industry in the State. A factory of 600 tons capacity is now building at Madison.

In some of the districts growing beets for these factories tobacco has been one of the principal crops, especially at Madison and Janesville. The county in which Madison is located grows annually about 12,000 acres of tobacco, and that in which Janesville is located about 10,000. The beet crop is becoming popular with the tobacco growers. The best crops secured in these districts, both in quality and yield, are those grown by experienced tobacco growers on tobacco land. Both involve intensive cultivation and leave the ground in splendid shape for the crop succeeding it in the rotation.

Results in Wisconsin justify considerable extension of the beet-sugar industry in the State. Factory installation is proceeding along the right lines. As soon as a district has grown sugar beets sufficiently, and farmers are well advised regarding methods, a new factory is built to meet the demand. In this way the experience of the State is similar to that of Utah. Under such conditions there can be no mistake in the installation of factories. During this season several places received serious consideration by the factory people of the State and outside capitalists. They are as follows: Menomonie, Kaukauna, Dodgeville, Lancaster, and Sparta.

#### WYOMING.

The State of Wyoming has been under investigation and experimentation for some time. It has conditions very favorable to beet-sugar production. Beets grown almost anywhere in the valleys of Wyoming show unusually high quality. Where sufficient water is developed for irrigation, the soils generally return a good yield of sugar beets. The State has large deposits of coal and crude oil, both of which furnish cheap and good fuel. These conditions have attracted capitalists and investors generally. Both the large sugar concerns operating in Utah and some of those in Colorado have been



giving this State special investigation. Conditions favorable to the establishment of the sugar industry are generally conceded by all. The principal drawback is its lack of railroad and irrigation facilities. In order to carry into execution the many plans now being arranged to develop the sugar industry, transportation and irrigation must be developed. Wyoming landowners, business men, ranchmen, and others have made many excursions into the States of Colorado and Utah during the season to study the benefits of the beet-sugar industry. At the same time high officials in railroad companies, eastern capitalists, and managers of sugar concerns have jointly and separately visited the State, investigating its advantages for sugar production. Many plans are now being arranged to bring about the installation of sugar factories and the introduction of other improvements necessary to their success and the general settlement and improvement of the district. Natural conditions are somewhat similar to those in Colorado. Indications point to the opening of this State in the near future to the work of sugar production. There are several plans maturing. We are likely to see this State, like Idaho, suddenly jump into prominence in this industry.

The places having plans most nearly matured at the present time and possessing conditions adapted to the industry are as follows:

**EVESTON.**—Eveston is in the midst of a large stock-raising industry. The stockmen have been investigating the sugar industry and feel that such an enterprise would be materially helpful to feeders.

**GRAND ENCAMPMENT AND SARATOGA VALLEYS.**—These places have received considerable attention during the season from investors and those representing large railroad interests. The interest here is principally stimulated by the Union Pacific Railroad. Eastern people have invested in about 300,000 acres of land, which is to be reclaimed. The sugar industry is regarded as the principal means for accomplishing this. The scheme anticipates the building of three or four factories in these two valleys.

**LOVELL.**—Lovell is in a locality settled largely by Mormons from Utah. For this reason the people are especially interested in sugar production. The Utah Sugar Company has given this place considerable favorable investigation, and prospects are fair for the establishment of a factory here in the near future.

**SHERIDAN.**—Sheridan is in the northern part of the State in Sheridan County on the Burlington and Missouri River Railroad. The district has been thoroughly investigated by many parties interested in beet-sugar production. A factory at this place seems quite probable in the near future.

**WORLAND.**—This is on the Burlington Railroad and in the Big Horn Valley. Farmers here have contracted to grow 1,500 acres of beets for the factory at Billings, Mont., for the campaign of 1906. It is thought that plans already outlined for this place will mature and that



a factory will be established here for the campaign of 1907. As yet the country is quite new. Agricultural production is aided through irrigation from the Hanover Canal. The plans for establishing a factory here include the building of a new railroad, opening up a very valuable and desirable area for growing beets and other field crops.

OTHER PLACES.—Rawlins and Wheatland are two other places which have been considered to some extent. Lands have been tested, and negotiations looking to the establishment of factories have been under consideration. Enough has been established to warrant the conclusion that these places are adapted to the beet-sugar industry.

### STATISTICS OF THE SUGAR INDUSTRY.

Under this heading I include (1) tabulated information relating to the beet-sugar industry in the United States; (2) statistics of the world's sugar production compiled from the reports of Willett and Gray; and (3) some interesting statistics showing improvement of sugar beets in Europe.

#### STATISTICS OF THE BEET-SUGAR INDUSTRY OF THE UNITED STATES FOR 1905.

This information is presented in substantially the same form as in my previous reports. In nearly all cases the figures for production have been furnished by the factory managers. As the managements of these concerns are in most cases averse to making public the facts relating to their operations, these statistics are given in such a way as to conceal the identity of the individual factories.

In the first of the two tables the data are given by States. Where there is more than one factory in a State the data have been combined, so as to show the totals and averages for all the factories in the State. In several cases, however, there is but a single factory in a State. Here, to avoid giving publicity to facts relating to individual concerns, the data for all such factories are combined (see "other States" at bottom of table).

In the second table are given the averages for tonnage of beets per acre, percentage of sugar in beets, coefficients of purity, extraction of sugar, and the length of campaigns for the individual factories. Here, again, the identity of the individual concerns is concealed by the use of numbers instead of names of factories, and the data for a number of factories have been combined (see "averages of all others" at bottom of table).

The figures for acreage may be presumed to be as reliable as such statistics usually are. Still it must be remembered that farmers seldom know the exact area of their fields, and in more than one-half the cases the factory managers have merely estimated the acreage in "round numbers."

The figures for tonnage of "beets worked" are doubtless fairly accurate, though "round numbers" were reported for about one-half the factories.

The tonnage of beets per acre was calculated from the data for acreage and tonnage of beets worked and involves no elements of doubt or error, except such as might result from inaccuracies in reporting acreage and tons of beets worked.

As the factories have exact knowledge concerning the amount of sugar produced, the figures under this head should be reliable. Still about one-half the factories reported in "round numbers." In some cases this was doubtless owing to the report being made before the manufacture of sugar for the year had entirely ceased.

The percentage of sugar in the beets, the coefficients of purity, and the length of campaigns are given as reported.

The extraction of sugar has been calculated from the figures for production of beets and sugar and involves only such errors as might result from inaccuracies in reporting tons of beets worked and tons of sugar produced. It should be noted, however, that in a number of cases the figures for extraction appear to be unreasonably high. This may in some instances have resulted from reporting as part of the year's product the sugar made from residues of brown sugar and molasses held over from the previous year.

The general averages for tons of beets per acre and extraction of sugar have not been found by taking "straight" averages of the figures for individual factories, but have been derived directly from the grand totals of acreage and production for the whole country. The general averages for percentage of sugar in the beets and coefficients of purity are merely "straight" averages derived from the figures reported for the individual factories. As a number of factories did not report on the quality of the beets worked, and these were in some instances factories whose results were presumably below the average, the general averages may be accepted as a little too high.

*General factory and farm results for 1905 by States.*

State.	Area. har- vested.	Average yield of beets per acre.	Beets worked.	Sugar manufactured.		Average sug- ar in beets.	Average pu- rity co- efficient of beets.	Average length of cam- paign.	Esti- mated average ex- trac- tion of sugar.
				Pounds.	Tons.				
	<i>Acres.</i>	<i>Tons.<sup>a</sup></i>	<i>Tons.<sup>a</sup></i>			<i>Per ct.</i>	<i>Per ct.</i>	<i>Days.</i>	<i>Per ct.</i>
California.....	51,857	9.92	514,391	147,786,900	73,893.45	17.27	81.33	91.5	14.37
Colorado.....	85,916	10.19	875,154	183,216,900	91,608.45	14.71	81.79	101.1	10.47
Idaho.....	16,800	8.63	145,000	31,000,000	15,500.0	14.47	84.3	47.7	10.69
Michigan.....	77,823	6.83	531,475	132,917,999	66,458.99	15.65	84.67	58.9	12.32
Nebraska.....	16,218	7.08	114,833	22,174,400	11,087.2	12.3	77.0	99.5	9.66
Utah.....	27,750	8.02	222,660	48,428,000	24,214.0	14.03	80.85	66.2	10.87
Wisconsin.....	14,000	8.86	124,000	28,487,029	14,243.51	15.0	83.0	85.0	11.49
Other States.....	17,000	8.14	138,400	31,830,000	15,915.0	15.78	85.2	71.0	11.5
Total and average.	307,364	8.67	2,665,913	625,841,228	312,920.60	15.33	82.96	76.6	11.74

<sup>a</sup> Short tons of 2,000 pounds.

<sup>b</sup> States in each of which there is but a single factory.

*General factory and farm results, by individual factories, for 1905.*

Number of factory.	Average yield of beets per acre.	Average sugar in beets.	Average purity coeffi- cient of beets.	Length of cam- paign.	Average extrac- tion of sugar.
	<i>Tons.<sup>a</sup></i>	<i>Per cent.</i>		<i>Days.</i>	<i>Per cent.</i>
1.....	10.83			45	10.0
2.....	7.95	17.23	82.88	50	13.65
3.....	5.67			60	10.0
4.....	6.60	15.2	84.0	60	13.55
5.....	8.0	15.35	86.5	78	12.54
6.....	11.54	17.9	79.4	76	<sup>b</sup> 15.6
7.....	9.8	14.9	81.0	125	12.0
8.....	5.0	16.2	83.9	58	13.0
9.....	7.28			56	11.92
10.....	6.31	15.96	86.26	90	13.62
11.....	7.14			47	11.0
12.....	7.33	14.13		63	10.61
13.....	7.33	15.1		60	10.61
14.....	7.11	16.0	85.0	49	13.44
15.....	6.12			87	9.71
16.....	8.0	15.2		58	12.5
17.....	3.68	15.0	85.0	25	10.71
18.....	12.5			114	11.0
19.....	10.66	18.0	86.0	160	13.62
20.....	7.88	15.3	85.51	44	13.51
21.....	6.67			67	11.0
22.....	3.92	16.0	85.0	37	12.5
23.....	7.42	12.3	77.0	112	9.64
24.....	7.0			59	11.79
25.....	6.2			70	12.1
26.....	10.87	14.96	79.7	73	12.52
27.....	8.07	15.1	81.7	90	10.56
28.....	7.97	15.0		60	11.94
29.....	11.18	13.9	83.4	68	10.53
30.....	9.87	14.25	83.2	83	11.15
31.....	9.87	14.2	83.2	95	.....
32.....	9.0	15.0	83.0	113	11.7
33.....	8.57	16.0	86.0	40	<sup>b</sup> 14.17
34.....	9.05	17.0	80.0	95	<sup>b</sup> 14.62
35.....	5.0		84.0	72	9.25
36.....	8.87	14.5	84.5	50	10.91
37.....	8.4	14.8	82.0	65	12.62
38.....	10.0			95	11.5
39.....	9.04	18.5	80.0	95	13.02
40.....	10.12	16.2	85.2	100	12.54
41.....	7.41	15.6	82.5	60	12.29
42.....	8.75	12.1	78.1	65	10.0
43.....	6.97	12.63	78.5	30	11.91
44.....	7.29			75	10.47
45.....	6.95	17.1	86.45	55	<sup>b</sup> 15.14
Average of all others.....	10.79	15.23	82.95	108	10.02
Averages.....	8.67	15.33	82.96	76.6	11.74

<sup>a</sup> Short tons of 2,000 pounds.

<sup>b</sup> These figures are unreasonably high. It appears probable that there is some inaccuracy either in the tonnage of beets worked or in the tonnage of sugar produced as reported by these factories. In some cases the tonnage of sugar reported for the year is too high, owing to the inclusion of sugar made from residues of brown sugar and molasses held over from previous year.

## SUGAR PRODUCTION OF THE WORLD.

The following table shows the production of sugar for the world for the five years beginning with 1901-2 and ending with 1905-6:

*Sugar production of the world.*

[Prepared in the Division of Foreign Markets, Bureau of Statistics.]

Country.	1901-2.	1902-3.	1903-4.	1904-5.	1905-6.
<b>CANE SUGAR.</b>					
United States:	<i>Tons.<sup>a</sup></i>	<i>Tons.<sup>a</sup></i>	<i>Tons.<sup>a</sup></i>	<i>Tons.<sup>a</sup></i>	<i>Tons.<sup>a</sup></i>
Louisiana and Texas.....	321,676	329,226	234,800	350,000	342,000
Hawaii.....	317,509	391,062	328,103	380,576	370,000
Porto Rico.....	85,000	85,000	130,000	145,000	210,000
Total United States <sup>b</sup> .....	724,185	805,288	692,903	875,576	922,000
Cuba.....	850,181	998,878	1,040,228	1,163,258	1,300,000
Other West Indies.....	282,410	200,163	268,306	241,586	249,000
Mexico.....	103,110	112,679	107,547	107,038	105,000
Central America.....	20,500	21,500	21,450	19,768	22,000
South America.....	761,805	579,022	601,134	590,382	693,308
Total America.....	2,742,191	2,777,530	2,731,508	2,997,608	3,291,138
Asia.....	2,868,243	2,839,596	2,841,547	3,281,931	2,854,825
Africa.....	278,926	277,473	321,706	232,101	295,000
Oceania.....	169,858	133,126	163,328	214,688	223,000
Europe.....	28,000	28,000	28,000	28,000	28,000
Total cane-sugar production.....	6,087,218	6,055,725	6,086,149	6,754,328	6,692,133
<b>BEET SUGAR.</b>					
United States.....	163,126	195,463	208,135	209,722	283,717
Canada.....		6,696	6,710	8,034	11,419
Total America.....	163,126	202,159	214,845	217,756	295,136
Europe:					
Germany.....	2,305,013	1,762,461	1,927,681	1,598,164	2,425,000
Austria-Hungary.....	1,301,548	1,057,692	1,167,959	889,373	1,510,000
France.....	1,123,545	833,210	804,308	622,422	1,085,000
Russia.....	1,098,983	1,256,311	1,206,907	953,626	1,000,000
Belgium.....	324,960	224,090	209,811	176,466	330,000
Netherlands.....	203,193	102,411	123,551	136,551	210,000
Other countries.....	393,236	325,082	441,116	332,098	410,000
Total Europe.....	6,750,478	5,561,257	5,881,333	4,708,700	6,970,000
Total beet-sugar production.....	6,913,604	5,763,416	6,096,178	4,926,456	7,265,136
Total cane and beet sugar production.....	13,000,822	11,819,141	12,182,327	11,680,784	13,957,269

<sup>a</sup>In long tons of 2,240 pounds, except in the case of European beet-sugar production, which has been retained in metric tons of 2,204.622 pounds, as originally estimated by Licht. Other data are mainly from Willett & Gray, but in the case of India official estimates of production have been substituted.

<sup>b</sup>Not including the Philippine Islands, which are included under Asia.

## IMPROVEMENT OF BEETS IN EUROPE.

Below I offer some statistics taken from a report <sup>a</sup> prepared by F. R. Rutter, assistant chief of the Division of Foreign Markets, United States Department of Agriculture.

These tables will show the gradual improvement of quality of beets in Germany, Austria-Hungary, France, Russia, and Sweden, and the consequent gradual increase in the amount of sugar produced per acre in these foreign countries.

<sup>a</sup>Bul. 30. Bureau of Statistics: International Sugar Situation.



This is highly illustrative of the claims I have made in my reports that it takes years of experience in any locality or country to place the sugar industry at its highest efficiency.

AVERAGE YIELD OF BEETS.

During the last twenty years there has been a striking improvement in the methods of beet culture in the leading countries of Europe. The improvement has resulted not so much in the increased yield of beets per acre as in the larger sugar content of the beets.

In Germany, for instance, the average yield per acre in 1902 was less than 12 short tons per acre. This yield, however, was much below the average. For the last five years the average yield per acre was about 13 short tons, while the average yield for the five years 1882-86 was about 14 tons per acre. By care in the selection of mother beets and in the methods of fertilization and culture, the quality of the beet has been greatly improved, partly at the expense of tonnage. The factories require beets light in weight and rich in sugar.

AVERAGE SUGAR EXTRACTION.

The increase in the average amount of sugar obtained from a given quantity of beets is shown in the following table:

*Average extraction of sugar from beets (in percentages of weight of beets) in European countries, 1882-1904.*

Sugar year.	Average extraction of sugar in—				
	Germany.	Austria-Hungary.	France.	Russia.	Sweden.
	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>	<i>Per cent.</i>
1882-83.....	9.51	10.08	5.05	8.51	.....
1883-84.....	10.54	11.23	5.65	9.41	7.81
1884-85.....	10.80	11.66	6.00	9.45	9.11
1885-86.....	11.43	11.75	8.20	9.58	9.06
1886-87.....	12.26	11.83	9.55	10.03	10.30
1887-88.....	13.77	12.31	9.92	10.12	10.98
1888-89.....	12.55	10.73	10.25	11.25	10.31
1889-90.....	12.84	11.69	11.08	10.65	10.69
1890-91.....	12.58	11.39	9.87	10.48	9.45
1891-92.....	12.63	11.51	10.83	12.55	10.32
1892-93.....	12.54	11.10	10.04	12.16	10.78
1893-94.....	12.83	12.48	10.28	11.38	11.54
1894-95.....	12.59	11.80	10.43	10.98	11.60
1895-96.....	14.02	13.36	11.54	12.89	10.75
1896-97.....	13.27	11.79	10.38	12.16	11.86
1897-98.....	13.46	11.91	12.07	11.98	12.42
1898-99.....	14.18	13.27	12.81	12.38	12.33
1899-1900.....	14.43	12.85	12.42	12.02	12.99
1900-1901.....	14.93	14.26	12.62	13.66	13.10
1901-2.....	14.38	14.40	11.87	12.98	13.87
1902-3.....	15.87	14.71	13.14	13.07	14.34
1903-4.....	15.18	14.85	12.33	15.42	.....

## PRODUCTION OF SUGAR PER ACRE.

The average yield of beets per acre and the average sugar extraction shown in the above table bring out different aspects of the progress in the beet-sugar industry. A more accurate measure of improvement, both on the farm and in the factory, is the average sugar production per acre, as shown in the following table:

*Average production of sugar per acre in European countries, 1882-1904.*

Sugar year.	Average production of sugar per acre in—				
	Germany.	Austria-Hungary.	France.	Russia.	Belgium.
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>
1882-83.....	2,917	1,873	1,588	1,110	.....
1883-84.....	2,811	.....	1,750	1,008	.....
1884-85.....	3,169	2,015	1,621	1,068	.....
1885-86.....	3,089	1,814	2,071	1,444	.....
1886-87.....	3,281	1,894	2,752	1,427	.....
1887-88.....	4,890	1,722	2,328	1,525	.....
1888-89.....	3,155	1,954	2,478	1,717	.....
1889-90.....	3,768	2,282	3,126	1,536	.....
1890-91.....	3,619	2,127	2,382	1,518	.....
1891-92.....	3,180	2,146	2,433	1,566	.....
1892-93.....	3,120	2,062	2,165	1,371	.....
1893-94.....	3,159	2,050	2,144	1,719	3,766
1894-95.....	3,697	2,277	2,656	1,591	3,177
1895-96.....	3,870	2,320	2,767	1,806	3,225
1896-97.....	3,819	2,426	2,916	1,754	3,475
1897-98.....	3,761	2,380	3,094	1,589	3,351
1898-99.....	3,610	2,584	2,872	1,518	3,468
1899-1900.....	3,757	2,940	2,862	1,615	4,068
1900-1901.....	3,950	2,767	2,926	1,493	3,981
1901-2.....	4,297	3,165	2,813	1,789	4,071
1902-3.....	3,728	3,028	2,919	1,704	3,553
1903-4.....	4,144	3,352	3,031	1,922	3,008

## REPORTS FROM AGRICULTURISTS OF SUGAR FACTORIES.

## ON THE PRACTICE OF IRRIGATION.

In order to get an idea of the practical methods in vogue in various beet-growing districts under irrigation, I wrote a letter to the agricultural superintendents connected with western factories, soliciting replies to eight questions. These were arranged to bring out the information usually sought by those investigating this subject.

Below will be found my communication, followed by the replies of the superintendents:

I am preparing for my next annual report a chapter on irrigation. As you are doubtless deeply interested in the upbuilding of the beet-sugar industry and are familiar with the practical work of growing beets under irrigation, I wish you would prepare for me a statement of facts, based on your experience, in answer to the following questions:

1. What about "irrigating up" the beets?
2. At what stages is irrigation most beneficial?
3. What do you estimate the rainfall to be in your district during the growing season?
4. With the usual rainfall, how many times do you irrigate?
5. How much water do you put on the land in one irrigation—how much altogether?
6. What does each irrigation cost per acre, how much of this cost is due to cost of water, how much is due to cost of labor, etc.?
7. Is the general tendency among farmers to overirrigation or underirrigation?
8. What is the general price of water in your district?

REPLIES TO QUESTION NO. 1.

*Grand Junction, Colo.*—"We irrigate up practically all our beets."

*Lehi, Utah—Springville Station.*—"Very few irrigated up."

*Rocky Ford, Colo.*—"Last season the largest portion of the beets came up without irrigation on account of frequent showers. A portion was irrigated up successfully by running the water in every other row, the furrows being made with shovels attached to the seeder."

*Grand Island, Nebr.*—"We had plenty of rain; had no occasion to irrigate before beets came through ground."

*Holly, Colo.*—"We have had a great deal of experience in irrigating up beets, and when the water can be secured at the proper time have found this method very successful."

*Lehi and Garland, Utah.*—"As a rule it is very unsatisfactory to irrigate beets up. It usually leaves the land in a very bad condition for thinning and cultivating."

REPLIES TO QUESTION NO. 2.

*Grand Junction, Colo.*—"After irrigating up our next irrigation is right after the thinning, and from that time on we irrigate whenever the beets seem to need water."

*Lehi, Utah—Springville Station.*—"July and August when beets cover ground."

*Rocky Ford, Colo.*—"Time of irrigation depends upon condition of soil and rainfall during spring; it is usually advisable to delay irrigation until the beets have been thinned and then apply about two irrigations."

*Grand Island, Nebr.*—"After first hoeing is completed."

*Holly, Colo.*—"Irrigation is most beneficial during the hot dry summer season and during the time the plant is growing, before it has gotten very large."

*Lehi, Utah—Springville Station.*—"In May, generally enough for one watering."

REPLIES TO QUESTION NO. 3.

*Grand Junction, Colo.*—"Our rainfall here is very irregular and we can not figure on it at all as far as beet raising is concerned."

*Lehi and Garland, Utah.*—"Rainfall is very uncertain in this State; some seasons not more than 2 inches from May 1 to October 1; some seasons we have 6 inches."

*Rocky Ford, Colo.*—"Average annual rainfall amounts to 12 inches."

*Grand Island, Nebr.*—"From 18 to 20 inches in this locality."

REPLIES TO QUESTION NO. 4.

*Grand Junction, Colo.*—"Not having any rainfall, we irrigate four or five times in a season."

*Lehi, Utah—Springville Station.*—"From two to five times, owing to quality of land."

*Rocky Ford, Colo.*—"With the usual rainfall two or three irrigations are applied."

*Grand Island, Nebr.*—"The usual rainfall in irrigated districts in western Nebraska is not over 12 to 14 inches during the growing period. In addition to this we irrigate two or three times."

*Holly, Colo.*—"With our usual rainfall we irrigate from three to four times during the growing season."

*Lehi and Garland, Utah.*—"Usually we irrigate three to four times, applying about 3 inches of water each time."

REPLIES TO QUESTION NO. 5.

*Grand Junction, Colo.*—"Will say that we figure from one-half to 1 inch in depth of water per acre for one irrigation."

*Lehi, Utah—Springville Station.*—"One second-foot two hours per acre."

*Rocky Ford, Colo.*—"No measurements have been taken regarding amount of water applied in one irrigation, but probably not less than three-fourths acre-foot in each irrigation."

*Grand Island, Nebr.*—"No measurements kept as to amount of water used."

*Holly, Colo.*—"We put on sufficient water to leave the soil in good moist condition, and it is difficult to measure this as it varies according to the soil."

## REPLIES TO QUESTION NO. 6.

*Grand Junction, Colo.*—"In regard to irrigation, will say that I can not tell how much it costs. Water rental here is \$3 an inch per year. They pay for labor here from \$1.50 to \$2.50 per day."

*Lehi, Utah—Springville Station.*—"Fifty-five cents per acre in all. Twenty cents per hour for labor, 5 cents for water—that is, where water is brought to land. Cost for bringing water to land is 50 cents per acre."

*Rocky Ford, Colo.*—"The cost of irrigation depends very much upon the lay of the land. If very uneven, very level, or very much grade the work is more difficult. Under average conditions each irrigation will cost about 50 to 75 cents per acre on account of labor. There is no charge for water, as the landowners own their stock in the ditches, the maintenance and repair of which usually costs from 50 cents to \$1 per acre of land watered."

*Grand Island, Nebr.*—"Twenty-five cents."

*Holly, Colo.*—"Irrigation costs about 50 cents per acre each time—25 cents for the water and 25 cents for the labor."

*Lehi and Garland, Utah.*—"Cost, about 50 cents per acre for labor for each irrigation; an additional charge of about \$1 per acre for the maintenance of permanent canals for the season; and I would say about \$1 per acre per annum for preparation for irrigation of beets."

## REPLIES TO QUESTION NO. 7.

*Lehi, Utah—Springville Station.*—"Farmers have learned that too much irrigation is as detrimental as not enough."

*Rocky Ford, Colo.* "If the farmers have a fair water supply there is a general tendency to overirrigate."

*Grand Island, Nebr.*—"Majority of growers are inclined to overirrigate the first few years."

*Holly, Colo.*—"The general tendency among farmers is toward overirrigation."

*Lehi and Garland, Utah.*—"As a rule the farmers are inclined to overirrigate until experience has taught them that too much water does not increase tonnage."

## REPLIES TO QUESTION NO. 8.

*Lehi, Utah—Springville Station.*—"About 75 cents per acre. By prior right that water belongs to the farmers. By usage we only pay for the regulating of it; that means cleaning ditches and a man to time each farmer."

*Rocky Ford, Colo.*—"Water rights to irrigate 80 acres are sold in this district at from \$2,400 to \$3,000, but the price is steadily increasing."

*Grand Island, Nebr.*—"Water can only be secured by parties owning water rights. Maintenance costs about 39 cents per acre."

*Holly, Colo.*—"Water in this district is not sold. Land is sold at various prices and the water is included with the price of the land."

## ON OPERATIONS IN BEET-GROWING DISTRICTS IN 1905.

Below will be found reports from various agricultural superintendents in response to the following letter of inquiry:

DEAR SIR: The Secretary of Agriculture is very anxious in the annual report on "The Progress of Beet Sugar Industry" to cover the field with as reliable, comprehensive, and complete information as possible. For the purpose of checking up my own observations and information on the subject I would be under many obligations if you would give a brief résumé of the conditions affecting the beet-sugar industry in your locality during the past season. The character of the information desired is indicated by the questions below. You can write as fully or as briefly as is consistent with your time and inclination.



All of us who participate in this work have some ideas worthy of publication, and I am especially desirous of including in this report the practical information and experience of the agriculturists of our sugar factories.

1. Describe the past season as affecting sugar-beet growing.
2. Is the beet crop growing in favor with farmers, and what are the causes affecting their attitude?
3. What new features have you developed that are favorable to the beet growing under your conditions?
4. What experiments have you conducted with fertilizers, beet seed, etc., and with what results?
5. Have any new labor-saving implements been brought out in your district?
6. Have any new labor-saving implements, local or otherwise, been tried in your district, and with what results?
7. How many contracting farmers has your company?
8. How many acres of beets were harvested?
9. What price do you pay for beets?
10. What are the prospects for 1906?
11. What seed do you usually plant, with proportion of different kinds?
12. Describe the kind of land, under your conditions, that gives the best results.
13. Under general remarks give anything you care to mention that will be of interest.

#### REPLIES TO QUESTION No. 1.

*Alma, Mich.*—"The season with us has been very discouraging, especially the forepart, which was very wet and quite warm. The ground seemed to sour worse than in a wet, cold season. Nothing grew the forepart of the season. The latter part was much more favorable; but we had some quite dry weather, which dried the ground that had been worked and puddled while too wet, and made it so hard that when harvesting began October 1 it was necessary in many instances to use two teams or three horses on one lifter to loosen the beets."

*Alvarado, Cal.*—"All crops were poor last season."

*Janesville, Wis.*—"We had a fairly good season here during 1905. The only drawback we had in the way of weather was some heavy rains about the time beets were planted which washed out a good many of the young plants, necessitating considerable replanting. Later in the season we had a period of dry weather that affected them slightly. To put it in common phrase, 'when it was wet it was too wet, and when it was dry it was too dry.'"

*Lansing, Mich.*—"The past season has been particularly trying in general. About 25 per cent of the acreage was destroyed by the excessive rains of the latter part of May and the first of June, our heaviest rainfall occurring on June 3, at which time there was a total fall of about 7.2 inches in twenty-four hours. Aside from this the season was fair in general."

*Leki, Utah—Springville Station.*—"Had blight. Raised about 50 per cent of what we generally raise, or about 8 tons per acre. All those who have contracted took their full acreage. I think we will have as many acres planted for season of 1906 as formerly."

*Lyons, N. Y.*—"Conditions on the whole have been fair, but the crop was damaged in some sections of the State by wet weather."

*Owasso, Mich.*—"The early part of last season was extremely wet and in ten days' time we lost about 3,000 acres. When the extreme wet weather did let up the planting of the beet seed was late, and on account of the lateness in planting the beets did not mature; consequently the tonnage was light and the sugar per cent low. This was the condition in some of our best districts."

*Rocky Ford, Colo.*—"The season was not favorable for the growth of the crop. The spring was cold. Hailstorms damaged the crop quite frequently during the summer, also insects."

*Saginaw, Mich.*—"The season was wet and very unsatisfactory."

*Grand Junction, Colo.*—"The past season we had a regular beet blight, which they had all over the country, and this affected us considerably in beet tonnage."

*Grand Island, Nebr.*—"Had entirely too much rain and cold weather during the growing season of the crop, which damaged it considerably."

*Holly, Colo.*—"The past season was not very good for beet raising, owing to the fact that the spring was late, and while the crop started out well it was damaged by all kinds of insects and pests."

*Lehi and Garland, Utah.*—"The past season the beet crop has been very light in this State on account of the leaf hopper, or what is here known as the 'white fly.' This insect attacked the beet crop about the middle of June and in many cases almost destroyed the crop, and particularly did this occur in the late planting."

*Croswell, Mich.*—"The past season and its effect upon sugar-beet growing was as follows: The latter half of April and a few days in May were extremely fine for seeding; the weather was mild and conditions were favorable in every way, but from the middle of May until about June 20 we were visited every week with extremely heavy rains, which not only ruined parts of many beet fields, but also made it impossible for many to finish seeding. From June 20 until the crop was harvested the weather was ideal, the beets grew rapidly, and our sugar percentages were higher than ever before."

#### REPLIES TO QUESTION NO. 2.

*Alma, Mich.*—"The crop seems to be growing in favor with the farmers. The worst drawback with us is the labor question."

*Alvarado, Cal.*—"Beet crops are growing in favor with farmers."

*Janesville, Wis.*—"Think the beet crop is growing in favor with the farmers because they find it a safe and sure crop, and one that they have a regular market for, and know when they are going to deliver, and when they get their pay. This season we are paying 50 cents per ton more for beets than last year, and I think we will have no trouble in getting a good acreage."

*Lansing, Mich.*—"The beet crop in this section is growing steadily in favor with the farmers, the cause of this growth being our endeavor to fit the crop into the farmer's general routine, (1) by confining the acreage to the amount which he can take care of properly; (2) by advocating the planting of beets 28 inches apart instead of 20 inches, thus placing the crop on a par with the other successful crops on the farm, with the exception of the thinning and topping; (3) by supplying hand labor in districts where the same is lacking under general conditions."

*Lehi, Utah—Springville Station.*—"Yes; because there is more clear profit from beets than from any other crop."

*Lyons, N. Y.*—"The crop is growing in favor among farmers who have had experience on account of the uniform price of the crop."

*Owosso, Mich.*—"The beet crop is growing greatly in favor with the farmers. This has resulted to some extent from observations of the crop during the extreme wet weather last year and the way in which the beets stood the water. Many fields were flooded for two or three days, but many of our good growers, even with this condition, were successful in raising very fair crops, which led them to believe that in ordinary seasons beets would be the farmers' money crop."

*Rocky Ford, Colo.*—"Beet acreage has increased from year to year, as it proves to be the most profitable crop in this section."

*Grand Junction, Colo.*—"The beet crop seems to be growing more generally into favor with the farmers."

*Saginaw, Mich.*—"We think the beet crop is coming into favor more and more with the farmers each year."

*Grand Island, Nebr.*—"Yes; because they realize more per acre than from any other crop."

*Holly, Colo.*—"The beet crop is growing very much in favor with the farmers, owing to its money-making properties."

*Lehi and Garland, Utah.*—"The beet crop is certainly growing in favor with the farmers in favorable locations where soil is adapted to beet culture, water plentiful, climatic conditions favorable, and land owned in small tracts."

*Croswell, Mich.*—"Our farmers are beginning to consider the beet crop one of their regular crops. The reason is they are becoming better acquainted with the methods of culture and with the factory processes and find it to be a paying crop."

#### REPLIES TO QUESTION NO. 3.

*Alma, Mich.*—"Nothing new has been developed, unless we should say that the land must be extra good and the crop have care at the proper time, if we expect very profitable returns."

*Lehi, Utah—Springville Station.*—"Only keeping ground well fertilized."

*Owosso, Mich.*—"In regard to new conditions developed, we have experimented very carefully on 28-inch rows and find that on an equal number of acres of 20-inch and 28-inch rows the average tonnage on the 20-inch rows was 12.38 tons, and the average per cent of sugar was 16, while on the 28-inch rows the average sugar was 16.2 per cent, and the average tonnage 12.4 tons. Certainly the crop can be handled \$5 or \$6 per acre cheaper with the 28-inch rows than with the 20-inch rows, as the farmer has all his tools to work the crop. We certainly expect to make a very large experiment along the same line another year. However, the above report covers a good many acres."

*Saginaw, Mich.*—"New features of development are drainage and roads."

*Grand Island, Nebr.*—"We have secured more and better hand labor."

*Holly, Colo.*—"We have found that fall plowing is very good for beet land."

*Lehi and Garland, Utah.*—"The beet crop, unlike any other crop the farmer raises, is sold before the seed is planted. Intensive farming from commencement to finish is very necessary. The more cultivation and hoeing the better will be the returns to the farmer. We have proven that plowing under the second crop of alfalfa in the latter part of July usually gives us excellent crops of beets for the next two or three seasons. Hence this has proven to be the cheapest fertilizer for this locality."

#### REPLIES TO QUESTION NO. 4.

*Grand Junction, Colo.*—"Will say that we fertilize here as much as we can with manure and try to get all of our growers to do this. We also try to get them to fall plow."

*Lansing, Mich.*—"In the past season we furnished our growers with fertilizer for use on the beet fields from one of the fertilizer companies. We find that in general this has been successful, inasmuch as it has given the crop a start in the spring, which is necessary to carry it through the usually damp and cold weather and puts the crop ahead as a consequence. If no other benefit was derived from fertilizer, this alone would compensate the farmer for using it."

*Lehi, Utah—Springville Station.*—"When barnyard manure can not be obtained the next best thing is alfalfa plowed under in April."

*Lyons, N. Y.*—"Experiments have been conducted with different kinds of fertilizers and seeds, but the results not fully digested."

*Owosso, Mich.*—"You will find inclosed copy of report on fertilizer experiments; also one on an experiment with beet seed in regard to small and large seeds."

*Results of test of beets grown from Jaensch seed screened in three sizes, large, medium, and small, 1905.*

Plat No.	Size of seed.	Weight of beets.		Sugar in beets.
		Lbs.	Oz.	
1	Large.....	1	1	15.9
2	Large.....	1	14	15.8
3	Large.....	1	8½	14.8
4	Large.....	1	6	14.9
5	Small.....	1	-----	14.2
6	Small.....	-----	14	16.2
7	Small.....	-----	15	15.2
8	Small.....	1	-----	16.2
9	Medium.....	-----	8½	15.3
10	Medium.....	1	-----	15.9
11	Medium.....	2	-----	14.8
12	Medium.....	1	4½	15.7

This shows that we had the highest per cent of sugar from the beets grown from small seeds and also smaller beets, while the large seeds show a little larger tonnage. A great many of our experiments were unsatisfactory this year on account of weather.

The following is a summary of the experiments conducted in 1905 with a commercial brand of tobacco and potato fertilizer:

#### EXPERIMENT NO. 1.

*Fertilization.*—Plat of 0.23 acre. May 24, 200 pounds of nitrate of soda per acre sown broadcast and harrowed in before seeding; 80 pounds per acre of the commercial fertilizer sown in rows.

*Result.*—Gross yield, 35,217 pounds per acre; tare, 10¼ per cent; net yield, 31,608 pounds, or 15.8 tons per acre; sugar, per cent, 13.4; value of crop, \$79.48 per acre.

#### EXPERIMENT NO. 2.

*Fertilization.*—Plat of 0.23 acre. May 24, 100 pounds of nitrate of soda per acre sown broadcast and harrowed in before seeding; 80 pounds per acre of the commercial fertilizer sown in rows.

*Result.*—Gross yield, 29,587 pounds per acre; tare, 8½ per cent; net yield, 27,072 pounds, or 13.5 tons per acre; sugar, per cent, 14.7; value, \$73 per acre.

#### EXPERIMENT NO. 3.

*Fertilization.*—Plat of 0.23 acre. No fertilizer of any kind.

*Result.*—Gross yield, 22,729 pounds per acre; tare, 15 per cent; net yield, 19,227 pounds, or 9.6 tons per acre; sugar, per cent, 13.3; value, \$47.43 per acre.

#### EXPERIMENT NO. 4.

*Fertilization.*—Plat of 0.23 acre. May 24, 100 pounds of nitrate of soda per acre sown broadcast and harrowed in before seeding; 80 pounds of the commercial fertilizer per acre sown in rows.

*Result.*—Gross yield, 25,504 pounds per acre; tare, 9 per cent; net yield, 23,094 pounds, or 11.5 tons per acre; sugar, per cent, 14.4; value, \$60.81 per acre.

#### EXPERIMENT NO. 5.

*Fertilization.*—Plat of 0.23 acre. May 24, 200 pounds of the commercial fertilizer per acre sown broadcast and harrowed in; 80 pounds of the same fertilizer per acre sown in rows.

*Result.*—Gross yield, 23,027 pounds per acre; tare, 6¼ per cent; net yield, 21,370 pounds or 10.68 tons per acre; sugar, per cent, 15.3; value, \$59.83 per acre.



EXPERIMENT NO. 6.

*Fertilization.*—Plat of 0.23 acre. May 24, 600 pounds of the commercial fertilizer per acre sown broadcast and harrowed in; 80 pounds of the same fertilizer per acre sown in rows.

*Result.*—Gross yield, 25,504 pounds per acre; tare, 10½ per cent; net yield, 22,431 pounds or 11.2 tons per acre; sugar, per cent, 15.7; value, \$64.30 per acre.

EXPERIMENT NO. 7.

*Fertilization.*—Plat of 0.23 acre. May 24, 80 pounds of the fertilizer per acre sown in the row.

*Result.*—Gross yield, 27,064 pounds per acre; tare, 7¾ per cent; net, 24,839 pounds or 12.4 tons per acre; sugar, per cent, 15.3; value, \$69.55 per acre.

EXPERIMENT NO. 8.

*Fertilization.*—Plat of 0.23 acre. May 24, 100 pounds of nitrate of soda per acre sown broadcast and harrowed in; 100 pounds of nitrate of soda sown broadcast July 17; 80 pounds of the commercial fertilizer sown in the rows.

*Result.*—Gross yield, 32,110 pounds per acre; tare, 11¾ per cent; net yield, 28,158 pounds or 14 tons per acre; sugar, per cent, 14.6; value, \$76.38 per acre.

EXPERIMENT NO. 9.

*Fertilization.*—Plat of 0.23 acre. May 24, 100 pounds of nitrate of soda per acre sown broadcast and harrowed in; 80 pounds of the commercial fertilizer per acre sown in the row.

*Result.*—Gross yield, 27,133 pounds per acre; tare, 13¾ per cent; net yield, 23,287 pounds or 11.6 tons per acre; sugar, per cent, 14.1; value, \$60.54 per acre.

*Rocky Ford, Colo.*—"None."

*Saginaw, Mich.*—"We are introducing fertilizer more and more each year and the results have been good."

*Grand Island, Nebr.*—"None."

*Holly, Colo.*—"The only fertilizers used are barnyard manure and alfalfa plowed under, both being very successfully used."

*Croswell, Mich.*—"We have conducted many experiments with fertilizers and beet seed. We find that it is very profitable to use fertilizer with the beet crop; it improves the stand, increases the yield, and generally gives a better sugar content. Beet seed is also a valuable consideration; there is much difference in results obtained from different seeds, especially in sugar percentage and tonnage."

REPLIES TO QUESTIONS NOS. 5 AND 6.

*Alma, Mich.*—"Have tried a beet harvester with pretty fair results. The machine should bunch the tops and leave the beets in small piles, and if it did would be a success, I think."

*Grand Junction, Colo.*—"The only new labor-saving implement which we have here is a beet puller and toppler combined, but it was sent here as a sample and we did not receive it in time to do much with it this past season and so can not tell you much about it."

*Janesville, Wis.*—"No new labor-saving implements have been originated in this district that we know of. There were tried in this territory two machines for topping and lifting, but they were both in rather a crude state and I do not think that they were entirely successful, although we think there is no doubt that they soon will be."

*Lansing, Mich.*—"No new labor-saving implements have been brought out which we consider worthy of notice. The placing upon the market of so many different tools along this line which are without merit has to a certain extent caused the farmer to dislike the beet crop, as it appears to him as a crop demanding an expenditure of a large amount of money for implements which can be practically of no other use on the farm. We submit that tools for the working of the beet crop should be built along the line of general farm implements

which can be used on other crops as well, and we advocate the planting of beets 28 inches apart in order to render this possible."

*Lehi, Utah—Springville Station.*—"No, not for several years."

*Owosso, Mich.*—"A new blocker came on the market, but for reasons already given was not a success. We also used a topper and lifter, but it was not a success."

*Saginaw, Mich.*—"None have been introduced with any success."

*Grand Island, Nebr.*—"No."

*Holly, Colo.*—"No new labor-saving implements have been brought out. A few small experiments have been made with labor-saving implements in this district with no results."

*Lehi and Garland, Utah.*—"In many cases the implements used to-day result in a great saving of labor; the horse cultivator and the beet puller, for instance, save a great deal of hoeing in the first place and make the harvesting easier and cheaper. Many suggestions have been made by us to manufacturers of the East, and as a rule have been adopted with very satisfactory results."

*Croswell, Mich.*—"We have tried many implements supposed to be labor saving, but none have proven to be valuable. Blocking machines and harvesters have been tried, but haven't proven satisfactory."

*Lyons, N. Y.*—"Some new implements have been given short trials, but not enough to determine their usefulness."

*Rocky Ford, Colo.*—"A beet harvester was tried in this section, but without success."

*Saginaw, Mich.*—"There have been some attempts, but no results."

#### REPLIES TO QUESTIONS NOS. 7 AND 8.

*Alma, Mich.*—"We had 1,185 contractors; harvested 5,471 acres of beets."

*Alvarado, Cal.*—"There are 300 contracting farmers here; number of acres of beets harvested, 4,511."

*Grand Junction, Colo.*—"We have about 800 contracting farmers; harvested last season 4,800 acres."

*Janesville, Wis.*—"The number of contracting farmers was about 2,200; harvested approximately 6,000 acres."

*Lansing, Mich.*—"We had during the past season about 1,500 contracting farmers, and we harvested 4,074 acres of beets."

*Lehi, Utah—Springville Station.*—"Number of contracting farmers, 300; number of acres harvested, 2,000."

*Lyons, N. Y.*—"About 1,500 contracting farmers; acres harvested, 4,900."

*Owosso, Mich.*—"The number of farmers we had contracted with last year was 2,318, and the number of acres harvested was 7,520."

*Rocky Ford, Colo.*—"Contracting farmers, 1,165; acres harvested, 12,761."

*Saginaw, Mich.*—"Farmers growing beets under contract, 1,500; acres harvested, 4,500."

*Grand Island, Nebr.*—"The contracting farmers numbered 468; acres harvested, 4,218."

*Holly, Colo.*—"We had over 500 contracting farmers for 1905 and harvested about 5,000 acres."

*Lehi and Garland, Utah.*—"For Lehi and Garland about 3,000 farmers, averaging about 6 acres each. Our acreage has grown from 2,000 in 1891 to 18,000 in 1905. As a rule, 95 per cent of beets are harvested. The past season, however, only about 75 per cent of the area planted was harvested on account of the white fly."

*Croswell, Mich.*—"We had about 1,000 contracting farmers last season and harvested 2,600 acres."

*Lewiston, Utah.*—"About 800 contracting farmers and 1,910 acres."

REPLIES TO QUESTION NO. 9.

*Alma, Mich.*—"The price for beets is \$4.50 for a 12 per cent sugar content, with 33½ cents additional for each 1 per cent rise in test. We also had a \$4.75 per ton flat-rate contract for tared beets delivered at any one of our 11 weigh and tare stations, and we pay the freight."

*Alvarado, Cal.*—"Price of beets, \$5 per ton."

*Grand Junction, Colo.*—"We pay \$5 per ton for beets."

*Janesville, Wis.*—"The 1906 price for beets is \$4.50 per ton for beets testing 12 per cent or less, with an additional 25 cents per ton for each percentage above 12. That is our 'contract form No. 3.' Then we have a 'contract form No. 4,' under which we pay a flat rate of \$5 per ton."

*Lansing, Mich.*—"The price paid for beets averaged a trifle better than \$5.50 per ton."

*Lehi, Utah—Springville Station.*—"Price for beets, \$4.75 per ton."

*Lyons, N. Y.*—"Price of beets, \$5."

*Owosso, Mich.*—"We pay \$4.50 for 12 per cent beets and 33½ cents for each 1 per cent above."

*Rocky Ford, Colo.*—"Price of beets, \$5 per ton."

*Saginaw, Mich.*—"Our price is \$4.50 on a 12 per cent basis with 33½ cents per ton for each additional per cent of sugar, or a \$5 flat rate."

*Grand Island, Nebr.*—"Price of beets, \$5 per ton."

*Holly, Colo.*—"We pay \$5 per ton for beets and 50 cents more per ton for siloed beets."

*Lehi and Garland, Utah.*—"The prices paid for beets in Utah delivered at factory, containing 14 per cent sugar or over and with purity coefficient of 80, is \$4.75 per ton."

*Croswell, Mich.*—"Price per ton averaged \$5.50."

*Lewiston, Utah.*—"We pay \$4.50 per ton delivered at the factory for all beets having not less than a purity of 80."

REPLIES TO QUESTION NO. 10.

*Alma, Mich.*—"Prospects for 1906 are about fair. The scarcity of competent labor at reasonable prices keeps many from contracting, and the high prices of beans with the success of the crop last year, is turning some toward bean raising who otherwise would raise beets, if the beans had not done so very well last season."

*Alvarado, Cal.*—"Prospects for 1906 are better."

*Grand Junction, Colo.*—"Prospects for 1906 are fair, and we think that by 'rustling' we can get the required acreage. The season so far has been the finest kind of beet weather."

*Janesville, Wis.*—"The prospects for 1906 are very good."

*Lansing, Mich.*—"The prospects for the season of 1906 are of the best. We feel sure at the present time that we shall have all the acreage which our plant can handle."

*Lehi, Utah—Springville Station.*—"Prospects are good for 1906."

*Lyons, N. Y.*—"Prospects are good."

*Owosso, Mich.*—"Prospects were never better so far as contracts are concerned than they are for 1906. At this writing we have already contracts for 6,000 acres, and from present indications will reach 10,000 acres, our required amount."

*Rocky Ford, Colo.*—"Fair average will be grown for 1906."

*Grand Island, Nebr.*—"Prospects are pretty good."

*Holly, Colo.*—"The prospects for 1906 could not be brighter."

*Lehi and Garland, Utah.*—"The prospects for acreage the coming season are excellent. We have an abundance of snow in the mountains, which will insure a bounteous crop."

*Croswell, Mich.*—"Prospects for 1906 are exceedingly good, better than ever before."

## REPLIES TO QUESTION NO. 11.

*Alma, Mich.*—"Last season we planted eight different kinds of seed, viz, Braune, Dippe, Schreiber Elite, Schreiber Kleinwanzlebener, Original Kleinwanzlebener, Licht, Vorstadt, and American. The bulk of our seed was Braune, Dippe, Schreiber Elite, Original Kleinwanzlebener, and Licht.

The last-named seeds showed the following results:

Seed.	Average yield per acre.	Average sugar content.	Crop value per acre.
	<i>Tons.</i>	<i>Per cent.</i>	
Braune .....	7.91	15.9	\$45.94
Dippe .....	8.88	16.0	52.07
Schreiber Elite .....	7.29	18.0	47.39
Original Kleinwanzlebener .....	7.54	16.2	44.62
Licht .....	7.34	16.5	43.88

*Alvarado, Cal.*—"Kleinwanzlebener seed used."

*Grand Junction, Colo.*—"In regard to seed will say that we plant several different kinds, but the principal one is the Kleinwanzlebener."

*Janesville, Wis.*—"We use Kleinwanzlebener seed."

*Lehi, Utah—Springville Station.*—"We use a German seed—I do not know the name."

*Lyons, N. Y.*—"The seeds we use are Elite Kleinwanzlebener, Heine Kleinwanzlebener, Dippe, Schreiber Special, and Original Kleinwanzlebener."

*Owosso, Mich.*—"Find inclosed report as to condition of seed and kinds used. Our present statistics in regard to this year's seed are not completed and we give you the last year's report."

*Seed results at Owosso, Mich., campaign of 1904.*

Seed.	Number of contracts.	Average size of contract.	Total area.	Tonnage of beets.	Value of beets.	Yield per acre.	Sugar content.	Crop value per acre.	Sugar per acre.	Value per ton.
		<i>Acres.</i>	<i>Acres.</i>	<i>Tons.</i>		<i>Tons.</i>	<i>Per ct.</i>		<i>Lbs.</i>	
Breustedt:										
Post contract.	189	4.4	824.9	8,349.6	\$47,950.70	10.10	15.72	\$57.97	3,175	\$5.74
Others .....	39	6.3	246.9	2,023.6	11,766.97	8.19	15.93	47.58	2,609	5.81
Dippe .....	80	3.9	309.3	2,565.6	15,319.59	8.29	16.41	48.91	2,721	5.97
Morrison .....	18	2.1	37.1	357.5	2,041.22	9.64	15.63	55.04	3,013	5.71
Heine .....	82	4.2	348.1	2,840.4	16,659.35	8.16	16.08	47.81	2,624	5.86
Rabbetke & Giesecke .....	82	3.5	288.9	2,268.5	13,614.92	7.85	16.50	47.10	2,591	6.00
Ziemann .....	81	3.4	274.8	2,084.7	12,935.30	7.59	17.22	47.36	2,614	6.24
Schreiber .....	103	2.8	292.3	2,249.1	13,469.21	7.69	16.47	46.06	2,533	5.99
Jaensch .....	93	3.6	333.3	2,524.7	14,061.80	7.58	15.21	42.22	2,306	5.57
Total and average...	767	3.85	2,955.6	25,263.7	147,819.06	8.55	16.05	50.01	2,743	5.85

*Rocky Ford, Colo.*—"Kinds of seeds used: Original Kleinwanzlebener, Schreiber, Dippe, Strandes, Braune, and Heine."

*Croswell, Mich.*—"We find the Kleinwanzlebener seed to be the best."

*Grand Island, Nebr.*—"Original Kleinwanzlebener and Dippe Kleinwanzlebener are the kinds of seed used here."

*Holly, Colo.*—"We have been using Strandes, Kleinwanzlebener, and Dippe seed, tending more toward Strandes seed which has given us the best results."

*Lehi and Garland, Utah.*—"Varieties of seed used: Kleinwanzlebener, Breustedt, Schreiber, Braune, Kuhn, and Dippe."



REPLIES TO QUESTION NO. 12.

*Alvarado, Cal.*—"The beet soil in use here is a sandy loam."

*Janesville, Wis.*—"We get the highest tonnage from our old tobacco ground; the highest sugar test from our lighter sandy soil."

*Owosso, Mich.*—"Our land is clay and clay loam. Dark clay loam gives the best results."

*Lansing, Mich.*—"The land which we find gives us the best results is a clay loam, tempered with sand sufficiently to place it in a condition where it can be worked easily and to advantage."

*Lehi, Utah—Springville Station.*—"Sandy loam gives the best results."

*Rocky Ford, Colo.*—"The heavy sandy loam usually gives the best results."

*Saginaw, Mich.*—"Best results are secured with clay loam."

*Grand Island, Nebr.*—"Sandy loam gives best results."

*Holly, Colo.*—"We have secured the best results from old alfalfa land plowed under a couple of times."

*Croswell, Mich.*—"We find that black clay loam underlain with a porous subsoil is our best sugar-beet land. It is usually termed black ash and elm land."

REPLIES TO QUESTION NO. 13 (GENERAL REMARKS).

*Alvarado, Cal.*—"No irrigation is used on the company's fields. They depend entirely upon the winter rains. The chief cause of the light crop last season was the blight. In some fields it was quite prominent, mostly on early beets. As the season advanced it showed more than at its first appearance."

*Lansing, Mich.*—"It is our opinion that, in order to promote this industry and bring it to the condition where it should be, we should reverse the methods which have been employed in the past. We should suit the crop to the farmer and the methods which we find upon the farms rather than endeavor to suit the farmer to the conditions which have been advocated as to the growing of beets. The principal point we would like to make in this connection is that of distance between rows. The trouble has been in the past that beets have been planted too close together. Very few farmers have the implements for the working of beets in rows 20 inches apart and they refuse to buy them; as a consequence we have the general neglect which the beet crop suffers. By planting the beets 28 inches apart we have found that our growers are fitted with a tool which does the work exactly as well as a beet drill and with the two-row riding cultivator such as is used in our district in beans (a favorite crop in our territory), we have a cultivator which does the best class of work and we secure a kind of cultivation which is far superior to that which we secure with a regular two-row beet cultivator. Under these conditions our hand labor costs less, while the tonnage is heavier."

With this mode of cultivation we feel that we are in a position to convince the ordinary farmer that the beet crop is one to be desired on the farm. After having gained this point and made the beet crop a general crop we feel that it would be much wiser to have these same farmers plant their beets 20 inches apart and give them the same kind of care they have given those planted 28 inches. In this way we feel that we can bring the standard of cultivation to the point where it belongs, and in this way increase the tonnage on account of the rows being closer together, and at the same time retain for the crop the good will which we have secured by this method."

*Lehi, Utah.*—"We have been raising beets for ten to twelve years on the same land. Think it ought to have a change. Will have a system of rotation of crops."

*Owosso, Mich.*—"We have a large number of farmers who are hauling beets 12 and 15 miles on wagons. One farmer had in 30 acres last year. His average gross receipts were \$60 per acre. After hauling the beets 12 miles over roads which were not the best he was well enough pleased to contract for 60 acres another season, claiming that, when his summer work is done, by proper care of the beets—getting them in large piles and siloing them—he

can haul beets when his teams have nothing else to do. This offers the best possible chance for work for him and his horses after the other fall work is done.

We are also in receipt of a report from a farmer who turned 11 head of cattle, young stock weighing 8,750 pounds all told, in a field after the beets had been topped. These cattle after two months feeding on tops alone weighed 9,510 pounds, a gain of 760 pounds or 8½ per cent. This shows what the farmers think of beet tops in this vicinity.

### REPORTS FROM STATE EXPERIMENT STATIONS.

In order to gather some information touching the work recently carried on by State experiment stations in States in which the beet-sugar industry has been established, I have kept in close touch with them both by visitation and correspondence. I offer some reports received during the past two years covering some of this experimental work, showing conditions and developments affecting this industry.

#### CALIFORNIA.

UNIVERSITY OF CALIFORNIA, COLLEGE OF AGRICULTURE,

*Berkeley, Cal., January 23, 1906.*

Mr. C. F. SAYLOR, *Pasadena, Cal.*

DEAR SIR: Your favor of the 15th instant addressed to the director of this station, has been referred to me. Many of the questions which you ask have no bearing upon the station work. I will, however, take up the matters which have fallen under our observation both in this State and in Colorado.

1. I beg to say that my experience with "irrigating up" beets has not been such as to warrant a favorable opinion of that method of securing a stand, the reason for this being that such treatment does not produce an even stand of beets. Far better results have usually resulted, in my observation, from thoroughly irrigating the land previous to sowing the crop and depending upon the moisture in the soil for germinating the seed. I can conceive of certain conditions under which it would be absolutely necessary to "irrigate up" the beets, but, as a general practice, I believe it to be unwise, and that the beets should be planted flat rather than in ridges, as there is a tendency for the seed to dry out in some places which do not take water as well as others.

2. Irrigation appears to be most beneficial previous to planting and in the second stage of the growth of the beet—that is, after the form of the beet has been set and it has attained its normal length. If irrigated too early, my observation has been that the beets become rather short and stubby, with a tendency to sprangle, making them undesirable for factory purposes and lessening the tonnage.

3. In this State the conditions are so different from those which exist in most other regions it is almost impossible to get a comparison of climatic conditions in corresponding months. Our rainfall which is of value to the beet crops is that which falls from October to the following March, and, as you probably know, in this State is a very variable factor.

5. Irrigation is practiced here to but a limited extent at present in the production of beets. However, the use of water for this purpose is increasing, and the industry has been saved in the region of Betteravia by the introduction of irrigation by pumping. The aim should be to add to the land enough irrigation water so that a natural precipitation, supplemented by irrigation, should be no less than 20 inches. The general tendency among farmers when they are beginning to irrigate beets is to overirrigate, although in the San Joaquin valley last season the general tendency was to irrigate too little, and not to put the land into proper shape for irrigation.

6. Under separate cover I am sending you a bulletin from our fertilizer division, which will enable you to secure such information as to fertilizer conditions in this State as you may desire.

Yours, very truly,

G. W. SHAW.

## COLORADO.

STATE AGRICULTURAL COLLEGE OF COLORADO,

DEPARTMENT OF AGRICULTURE,

Fort Collins, Colo., December 27, 1904.

C. F. SAYLOR, *Des Moines, Iowa.*

DEAR SIR: I have your favor of recent date, in which you make inquiry concerning the present status of our work with sugar beets. I will ask Mr. Danielson, my assistant in this work, to give you the results of his experiments with different kinds of fertilizers for growing sugar beets; also, the work we have done with home-grown and foreign-grown beet seed. I am also sending you with this a brief summary of our work last winter with beet pulp for feeding steers. We are now conducting an experiment which we hope will cover the ground a little more thoroughly in the way of demonstrating the value of beet pulp for cattle feeding. We have one lot of steers getting nothing but alfalfa hay; another getting all the beet pulp they will eat and alfalfa hay; a third lot getting hay and ground corn; and a fourth hay, ground corn, and beet pulp.

During the past season we had a most excellent crop of beets all over the State. The factory at Grand Junction had a very successful season for beets. This factory had been closed for two years. Yields of beets here last year (1904) were very heavy, the general average being 15 tons per acre, and some going as high as 24 tons. One field of 270 acres averaged 18.9 tons per acre. There is a surprising revival of interest in the growing of sugar beets, and the manager of the factory here has informed me that largely increased acreage is being signed. There is only one doubtful feature in beet growing, and that is the ravages of the leaf worm. It lowered the yield last year on some fields to an appreciable extent. No implements have as yet been thoroughly tested, except a harvesting machine, which was tried in the Longmont and the Windsor districts last year. It was said to be a success, and doubtless will be given a decisive test this year. Our sugar factories are now negotiating for large tracts of land with a view of growing their own beets, to some extent at least, and in this way being more independent of the farmers. I do not know to what extent they will be able to secure this land or just what effect it may have upon the industry.

Trusting that this information will be of value to you,

I am, yours, very truly,

W. L. CARLYLE.

## NEW YORK.

CORNELL UNIVERSITY, COLLEGE OF AGRICULTURE,

Ithaca, N. Y., December 22, 1904.

Mr. C. F. SAYLOR, *Des Moines, Iowa.*

MY DEAR SIR: Your letter of December 19 at hand. We are not doing very much in investigating the beet-sugar industry. The only experiment we had was the cooperative test in connection with the Bureau of Chemistry, to which beets were shipped weekly. Probably you are familiar with the outline under which this experiment is pursued. We have not issued any bulletins during the past year on this subject. Climatic conditions may be regarded on the whole as favorable. There was trouble in getting a stand, and we had to sow twice. I believe the tendency of thought in the State is that the industry can not be profitably pursued here. One factory (at Binghamton) went out of existence, moving farther west, and I do not know how long the Lyons factory may run. I have no intimate knowledge of their affairs. Personally I feel that three-fifths of a ton of sugar per acre, which is somewhere about our average, is not sufficient to warrant our farmers in growing this crop in competition with western men. This opinion is purely personal, but I think is warranted by the facts. We are trying to encourage the growing of roots, not particularly sugar beets, however, for dairy cattle. We feel that they may replace some of the concentrates in the rations which are now purchased at such a high price from



the West. The dry matter of mangels will run on an average with us about 4,000 pounds per acre, and may be over double this. It is worth about the same as grain—that is, one pound of the dry matter is equivalent to one pound of grain feed—so with corn at \$20 to \$28 a ton we should have a product worth about \$40 to \$100 an acre. This work is in the experimental stage. We have conducted rather extensive trials for the main types of roots, and different varieties of these, which will probably be issued in bulletin. This, however, is not sugar investigation, and may not be what you will be interested in.

In regard to sowing sugar beets and methods of cultivation, we have pursued those similar to other years, yields running from 8 to 11 tons of beets per acre. I can not give you the sugar content, as I have not received the same from the Bureau of Chemistry. It would seem that interest in the extensive experiments which were conducted some years ago by this station and the Geneva Station with this crop has cooled off, and that very little is being done at present.

Yours, very truly,

S. FRASER.

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UTAH.

EXPERIMENT STATION,  
Logan, Utah, January 19, 1905.

Mr. C. F. SAYLOR, *Des Moines, Iowa.*

DEAR SIR: The reply to your letter of December 19 has been long delayed owing to my frequent absences from my office. At the present time we are carrying on experiments on (1) the amount of water required for the production of sugar beets; (2) the time to apply the water; (3) the method of applying the water; (4) the effect of various methods of irrigation on the yield and sugar content of sugar beets; (5) the production of beet seed from different varieties of beets grown with different amounts of water; (6) the improvement of the sugar beet by proper selection, breeding, and irrigation. We are also doing some work on the proper fertilization of the sugar beet in the intermountain country.

The work of seed production is carried on in cooperation with the Bureau of Plant Industry of the Department of Agriculture under the direction of Prof. A. J. Pieters. We are also carrying on experiments on the feeding value of beet pulp and yard molasses for hogs, sheep, and milk cows. Some of these results have been published in our Bulletin No. 90, a copy of which I send you under separate cover.

These feeding tests with the sugar beet and beet products are yielding very interesting results. Of course it takes considerable time before definite data are obtained from such work. The results that we have accumulated during the past few years we are now preparing in bulletin form.

The sentiment in the State of Utah is very favorable to the beet-sugar industry. The industry has done a great deal for the State in the way of improving the conditions of our farmers and of bettering the general agricultural practices of the State. There is constant talk of new factories being established, and it seems very probable at the present time that at least two more factories will be erected in the State in time for next season's work. There is also considerable talk among the farmers relating to labor-saving devices that may be used in the production of sugar beets. One or two inventions have already been made in the way of agricultural implements with which, however, I am not familiar. So far as I can judge, the present status of the industry in this State is first class.

I am, very respectfully, yours,

JOHN A. WIDTSOE, *Director.*



## WISCONSIN.

UNIVERSITY OF WISCONSIN,  
COLLEGE OF AGRICULTURE,  
Madison, Wis., December 16, 1905.

C. F. SAYLOR, *Special Agent, Des Moines, Iowa.*

DEAR SIR: Your letter of the 13th instant to Director Henry has been received and referred to me. I take pleasure in sending you, in compliance with your request, a copy of the account of the beet-sugar investigations conducted at our station during the past year (1905). This will go into the 22d annual report of our experiment station, which is now in press.

I do not know that there is much else to be said as regards the situation in this State. The three sugar factories already established have received much larger quantities of beets this year than last, as you will see from the statistics which these factories will be likely to furnish you. The sugar factory here in Madison, which is now in process of construction, will be ready in ample time for next campaign and contracts for acreage are now being signed in the surrounding counties. The factory has a capacity of 600 tons and is built so that it can be enlarged to 1,000 tons by increasing the capacity of the machinery. Everything considered, the prospects for a steady growth of the beet-sugar industry in this State are very bright. The general situation in this State has been discussed at some length by me in our Bulletin No. 123, published last spring.

Respectfully,

F. W. WOLL.

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[The following is the account of the investigations which Mr. Woll refers to in his first paragraph.]

EXPERIMENTS WITH SUGAR BEETS, SEASON 1905.

By F. W. WOLL, R. A. MOORE, and A. L. STONE.

The industry of growing sugar beets for factory purposes has now become firmly established in this State. One factory has been in operation for four seasons, and during the season of 1904-5 three factories were in operation within the borders of the State, which produced in all nearly twenty-four million pounds of white granulated sugar from about 110,000 tons of beets. In addition, a fourth factory, located across the State line at Menominee, Mich., was supplied with about two-thirds of its beets from Wisconsin farms and produced from these beets about four million pounds of sugar. The prospects for an increase in the number of factories in the State are very bright, one factory being in the course of construction at Madison at the present time and others being contemplated at various places in the State. The general situation as to the Wisconsin beet-sugar industry has been discussed in Bulletin No. 123 of this station. This bulletin is still available for distribution, and will be of interest to farmers who expect to take up sugar-beet culture and become patrons of a sugar factory or who wish to inform themselves as to the situation in this State with respect to the beet-sugar industry.

The work done by this station in the line of sugar-beet experiments during the past season included (a) variety and fertilizer tests, and (b) growing an acre of beets for the Dane County Sugar Company.

(a) *Variety tests of sugar beets.*—The variety and fertilizer tests were conducted on a field one-fifth of an acre in area, located in the rather sloping southwest corner of the experimental plats at the Hill farm. The soil is a light sandy loam which had been reduced to a low state of fertility through continuous cropping by the former owners, no manure having been put on the land for at least ten years past. The east and west quarters of the field were left unfertilized, while the middle half received an application of nitrate of soda, superphosphate, and sulphate of potash, at the rate of 30 pounds of each fertilizing ingredient per acre. The land was plowed in the fall of 1904 and carefully prepared in the spring of

1905 by disking and harrowing in the usual manner for root crops. The fertilizers were put on shortly before planting the seed on May 4. The stand secured was not very satisfactory, in part owing to the planter used, which proved defective. The planter generally used for putting in beet seed was not available at the time. The early part of the season was characterized by frequent heavy rains that washed the ground, in many instances causing the plants to be covered with dirt. Low temperatures also prevailed at this stage of the growing period. In July, and still more during August and September, the weather turned hot and dry, and the drought became extremely severe during the latter month. The relatively small tonnage of beets secured from the plats is doubtless to be traced mainly to this cause.

The varieties of high-grade imported sugar-beet seed planted in these trials will be seen from the following table, which also gives information as to the origin and viability of the seed, weight per hundred seed balls, and number of balls not germinating after fourteen days. The seed of four of the varieties included in these trials was furnished by the various sugar companies doing business in the State at our request for samples of the seed supplied by the management of the factories to their respective patrons.

*Results of variety tests of sugar-beet seed, 1905.*

Name of variety.	Origin.	Weight.	Germination in—		No. of balls not germinating.
			7 days.	14 days.	
		<i>Grams.</i>			
Hoerning's improved.....	Dane County Sugar Co ....	2.04	95	109	45
Schaefer Grosswanzlebener.....	F. Dühne, Milwaukee .....	1.87	77	112	35
Schlandstedt Kleinwanzlebener.....	do .....	2.03	133	161	20
Braune Kleinwanzlebener .....	Chippewa Sugar Co .....	2.38	169	176	12
Breustedt Kleinwanzlebener.....	Wisconsin Sugar Co .....	2.53	140	154	27
Heine Kleinwanzlebener.....	do .....	2.18	115	129	29

As already stated, the middle portion of the field was fertilized, while the east and west ends received no fertilizer. All the varieties were, however, under exactly similar conditions in this respect and the results obtained for the entire part of the field planted to the different varieties are therefore given in the following table, which shows the results obtained at harvesting time.

The beets grown on the fertilized portion of the field were sampled September 21 and were analyzed in the chemical laboratory of our station by Geo. A. Olson, assistant chemist, who also made the analyses of the beets sampled at harvesting time. The former set of analyses resulted as follows:

*Results of analyses of beets grown on fertilized ground.*

	Average weight of topped beets.	Sugar in the beet.	Coefficient of purity.
	<i>Pounds.</i>	<i>Per cent.</i>	
Hoerning's Improved:			
North side of plat .....	1.2	16.30	90.0
South side of plat .....	1.8	15.10	81.8
Schaefer Grosswanzlebener .....	1.3	17.07	87.9
Schlandstedt Kleinwanzlebener.....	.8	16.53	87.6
Braune Kleinwanzlebener .....	1.0	15.72	79.5
Breustedt Kleinwanzlebener.....	1.2	17.06	89.4
Heine Kleinwanzlebener.....	1.9	16.53	89.5

The beets were harvested on October 24 and samples were secured of the beets grown on both the fertilized and the unfertilized portion of each plat. The results of the weighings of the beets and the average analyses of the samples of each variety will be seen in the follow-

ing table, which also gives the calculated yield per acre of beets and sugar, as well as the difference between the individual varieties and the average data for the entire field:

*Results of variety and fertilizer tests with sugar beets, Hill Farm, season of 1905.*

	Num-ber of rows.	Yield of beets.	Yield of sugar.	Aver-age sugar con-tent.	Aver-age coefficient of pu-rity. <sup>a</sup>	Calculated yield per acre of—	
						Beets.	Sugar.
		<i>Lbs.</i>	<i>Lbs.</i>	<i>P. ct.</i>		<i>Lbs.</i>	<i>Lbs.</i>
Hoerning (plat south) .....	3	334.3	55.87	16.7	88.2	12,257	2,048
Hoerning (plat north) .....	3	288.0	47.37	16.4	91.4	10,560	1,737
Schaefer .....	4	486.5	86.40	17.7	89.9	13,378	2,376
Schlandstedt .....	4	565.0	93.39	16.5	89.0	13,337	2,568
Braune .....	4	476.0	83.81	17.6	90.2	13,090	2,304
Breustedt .....	2	284.2	48.91	16.8	91.2	15,631	2,690
Heine .....	2	270.6	46.09	17.0	86.5	14,883	2,634
Totals and averages .....		2,704.6	461.84	17.0	89.6	13,619	2,337

<sup>a</sup> Arithmetical mean.

The figures for the calculated yields of beets in the preceding table show that the average for the entire field was less than 7 tons per acre and that of the calculated yield of sugar per acre was 2,337 pounds. The lowest yield of beets was obtained from the northern plat planted to Hoerning seed, viz, at the rate of 10,560 pounds of beets per acre, and the highest yield, 15,631 pounds, was obtained from Breustedt Kleinwanzlebener seed. The yields of beets, as well as of sugar from Breustedt, Schlandstedt, and Heine were above the average for the entire field, and the yield of sugar in the case of the Schaefer seed was also somewhat above average. The sugar content of the beets grown from seed of different origin ranged from 16.4 per cent (Hoerning, north plat) to 17.7 per cent (Schaefer). The beets grown from the latter variety and from Braune seed were the only kinds that contained more sugar than the average for the entire field. These two varieties with Hoerning (north plat) and Breustedt, were also above average in purity. In the case of all these varieties it will be seen, however, that both the sugar contents and the purity of the beets were exceptionally high, so that no serious criticism could be offered even with regard to the varieties showing the lowest results. The largest calculated yields of sugar per acre were obtained from the Breustedt, Heine, and Schlandstedt beets in the order given, and it will be seen that these three varieties gave considerably higher returns in sugar per acre than the beets grown from seed of other origin which was included in these trials.

(b). *Fertilizer trials.*—The trials were planned so that they might furnish information in regard to the effect of an application of a complete fertilizer, containing nitrate of soda, sulphate of potash, and acid phosphate, on the yield and quality of beets grown on the land. Plats A and C of the field did not receive any fertilizer, while the center half of the field, plat B, was fertilized, as previously stated. The same varieties of beets were grown on these plats, so that the data obtained furnish information as to the effect of the fertilization. The results obtained have been summarized and are given in the following table:

*Results of fertilizer trials with sugar beets, season of 1905.*

	Unfertilized plats.			Ferti-lized plat B.	Increase due to fertilization.	
	Plat A.	Plat C.	Plats A and C.			
	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Pounds.</i>	<i>Per cent.</i>
Yield of beets .....	387.0	730.8	1,117.8	1,586.7	+ 468.9	+ 41.9
Yield of sugar .....	63.11	123.66	186.77	275.07	+ 88.30	+ 47.3
Average per cent sugar .....	16.3	16.9	16.7	17.3	.....	+ 0.6
Average purity .....	87.9	90.3	89.1	90.2	.....	+ 1.1
Calculated yields per acre:						
Beets .....	7,740.0	14,616.0	11,178.0	15,867.0	+ 4,689.0	+ 41.9
Sugar .....	1,262.0	2,473.0	1,867.7	2,750.0	+ 883.0	+ 47.3



It will be noted that there was a marked improvement both in the yield and the quality of the beets grown on the fertilized half of the field as compared with the results for either of the end plats, which received no fertilizers. The average yield of beets secured from the field was small, but the quality of the beets was excellent, the average sugar content of the beets on the unfertilized plats being 16.9 per cent and on the fertilized plats 17.3 per cent, the average purity on the unfertilized plats being 89.1 and on the fertilized plat 90.2. Through the application of fertilizers the yield of beets was increased by 41.9 per cent and the yield of sugar per acre was increased by 47.3 per cent over the corresponding figures for the unfertilized plats. On account of the low yield secured in these experiments, computations in regard to the economy of using fertilizers would be of no special value. There can be no question, however, that applications of artificial fertilizers for sugar beets will amply pay on poor land like that used in these trials under ordinary conditions, when a good stand and at least a medium yield of beets are obtained.

*Sugar beets for factory purposes.*—An acre of beets was grown at the University farm during the past season under contract with the Dane County Sugar Company. The soil is a clay loam, toward the west quite rich in humus and not well drained. The land has been in pasture for several seasons past and was in a good state of fertility. It was plowed in the fall of 1904 and received treatment similar to the beet field on which the variety tests during the past season were conducted. The dates of planting, cultivation, laying by, etc., also corresponded quite closely with the respective dates for that field. The seed used was Hoerning's improved of the same stock as that planted in the variety tests.

The first sampling of the beets took place September 21, when it was found that the average weight of the topped beets in the large sample taken was 0.66 pound, the average sugar in the beet being 15.18 per cent and the average purity 88.7.

The ratio of tops to roots was 1:98. At harvesting time three samples were taken from different parts of the field, which were found to contain 16.52, 17.38, and 16.34 per cent of sugar, with purities of 90.7, 88.3, and 87.1, respectively. The averages of these figures—16.75 and 88.7—may be taken to fairly represent the sugar content and the purity for the entire field.

The yield of beets from the field was 23,065 pounds and the yield of sugar per acre, therefore, about 3,863 pounds. For the sake of comparison the average results obtained at our university farm in growing sugar beets during eleven seasons, 1890–1904, are given below.

*Average results obtained in growing sugar beets, university farm, 1890–1904.*

	Calculated yield per acre.		Average sugar content.
	Beets.	Sugar.	
	<i>Tons.</i>	<i>Pounds.</i>	
Average eleven seasons.....	17.37	4,900	14.10
Maximum results.....	a 29.94	a 8,213	b 16.9
Minimum results.....	c 7.34	d 2,503	e 11.8
Season 1905.....	11.53	3,863	16.75
Average for twelve seasons, 1890–1905.....	16.88	4,818	14.26

a 1902.

b 1892.

c 1891.

d 1897.

e 1903.

Owing to the unfavorable weather conditions during the past season the yield of beets secured was considerably below the average for the preceding eleven seasons, but the yield of sugar was nearly up to the high average reached during the earlier years, from the fact that the average sugar content of the beets was over 2½ per cent above the general average for the period during which these experiments have been conducted.



## SUGAR-BEET INVESTIGATIONS IN 1905.

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CONDUCTED BY THE BUREAU OF PLANT INDUSTRY.

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### LETTER OF SUBMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,  
BUREAU OF PLANT INDUSTRY,  
Washington, D. C., April 14, 1906.

SIR: I submit herewith for publication as part of the report on the "Progress of the Beet-Sugar Industry for 1905" a very brief account of the progress that has been made in certain lines of investigation carried on by experts of this Bureau relating to the growing of sugar-beet seed, the fertilization of sugar-beet crops, and the diseases affecting the crop. It should be noted that on none of these lines has the investigation progressed far enough to justify definite general conclusions.

Respectfully,

B. T. GALLOWAY,  
*Chief.*

HON. JAMES WILSON,  
*Secretary of Agriculture.*

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### SINGLE-GERM BEET SEED.

The publication of Bulletin No. 73 of the Bureau of Plant Industry has placed before the beet growers and experiment-station workers a description of the methods employed and the progress made in the attempt to produce the so-called single-germ beet seed. The value of this production, if accomplished, would be very great in view of the reduction of labor which would be brought about in the thinning of the beets. The reports issued by the Bureau state that the work has now progressed to a point where strains of beets have been secured which produce approximately 25 per cent of single-germ seed. This indicates very strongly that the experiment will be a success. Tests made with beets grown from single-germ seed the past season show that the sugar content of the beets is fully up to the standard.

### DISEASES OF THE BEET.

During the past season, as in previous years, two diseases of sugar beets were especially serious. In the eastern United States the eastern blight or leaf spot has in many places done considerably more damage than the growers realize. It has been shown that this disease mate-

rially reduces the tonnage as well as the sugar content of the beets, both by destroying leaves which would otherwise produce sugar and by forcing the beet to produce an additional number of leaves. The Department's work has shown that this disease may be prevented by spraying with Bordeaux mixture in very much the same way as spraying is carried on for potatoes. In the Rocky Mountain areas and on the Pacific coast the most serious disease has been the so-called curly top. No definite cause for this trouble has yet been worked out. The most important observation in connection with it is that it rarely occurs twice in the same place consecutively; thus if the disease is bad in a field this year it is almost certain that it will not appear in the same field next year. Although the trouble is probably due to some peculiar combination of unfavorable conditions of soil and climate, the particular combination has not yet been discovered.

#### **FERTILIZERS FOR SUGAR BEETS.**

For several years efforts have been made to increase the yield of beets by the application of various forms of fertilizers. The Department has tested green manures, stable manures, and commercial fertilizers. However, nothing additional to what was said in the report for 1904 can be reported.

#### **THE PRODUCTION OF SUGAR-BEET SEED.**

The work on the establishment of commercial sugar-beet seed growing has been carried on with reference to three problems: (1) The production of pedigree commercial seed; (2) the testing of American-grown seed in comparison with the best strains of European seed, and (3) the effect of soil and climate on the value of sugar-beet seed for conditions similar to those under which it was produced.

#### **COMMERCIAL PRODUCTION OF PEDIGREE SEED.**

To grow sugar-beet seed commercially, certain conditions are necessary which do not always apply to experimental work. It is necessary not only that seed of high quality be grown, but also that it be grown economically and that there be reasonable certainty of a crop. The climatic conditions at the time of harvesting are therefore of the utmost importance and may even be the determining factor in the successful production of seed in this country. While the experimental work may determine that seed of high quality can be grown in the eastern United States, it is possible that the uncertainty of the weather during the time of harvesting may render sugar-beet seed growing practically out of the question except in the Western States, where the summers are dry. This matter will, of course, be determined during the investigation. As soon as the Department is satisfied that sugar-beet seed can not be economically produced in the

Eastern States, experiments along that line will be discontinued. At present, however, the work of producing pedigree seed is being conducted in the States of New York, Michigan, Utah, and Washington; the two former represent typical eastern conditions, and Michigan represents a State in which the sugar-beet crop is an important one; the State of Utah represents conditions under which beets must be grown with irrigation, and the State of Washington represents conditions more nearly comparable to those in the Eastern States, except that the weather during the harvesting period of the seed is more certain.

So far the commercial production of sugar-beet seed has been practically confined to Utah and Washington States, and the seed grown in Utah has been very little used outside of that State. The seed grown in Washington State, while not from pedigree beets, has given general satisfaction wherever used and has proven superior to the average grade of factory seed imported from Europe. During the summer of 1904, which is the latest for which we have complete returns, this Department distributed 13,962 pounds of American-grown sugar-beet seed, by far the largest amount being Washington-grown. This seed was sent to farmers who were growing beets for the factories, and was therefore tested in direct comparison with the factory seed. These tests were carried on in 13 States and on 153 farms in these States, the entire area covering 564 acres. The results gave an average yield for the Washington-grown seed of 10.72 tons per acre, taking all States together, as against an average of 9.92 tons harvested from an equal area raised from factory seed. The sugar content of the Washington-grown seed averaged 15.41 per cent, while that from beets from factory seed averaged 15.26 per cent. Stated in another way, the American seed yielded, roughly, from 300 to 350 pounds of sugar per acre more than the imported seed.

The work of developing a strain of pedigree seed has gone far enough so that we shall be able to grow commercial crops of seed from these pedigree beets. When this is done, it is expected that a considerable improvement will be apparent over the original commercial seed. Some of the mother beets that have been used to establish lines of breeding have tested more than 24 per cent sugar and have at the same time been of good average weight—a pound and a half and over. The seed from such individual mother beets is carefully planted and the beets grown from it again selected and tested. This course determines which of these mother beets has the power to transmit its qualities. The progeny of such a beet—that is, one which is at the same time of high quality and has the power to impart that high quality to its descendants—is then used to establish a line of breeding.

## TESTING AMERICAN-GROWN SEED.

The testing of American-grown sugar-beet seed in comparison with various strains of European seed has given results practically identical with those above referred to. In this work, of course, it was not always factory seed that was used, but often seed that was received from European growers for test. Such seed was presumably of the best quality. Samples of European seed have been secured which gave higher yields than was secured from the American-grown seed, but such samples also were very far in advance of the seed supplied to factories.

## EFFECTS OF ENVIRONMENT.

It is contended by many European growers that sugar-beet seed should be raised under conditions under which the beets themselves are to be grown for the factory. If this is true, it means that factories in Michigan ought to use seed grown in Michigan; those in Nebraska, Nebraska-grown seed, and those in Utah, Utah-grown seed, and so on. The Department is working to solve this problem, but it must be remembered that from a practical standpoint the question is not only whether Michigan-grown seed will give a higher yield than, let us say, Washington-grown seed in Michigan, but whether this higher yield, if secured, will be sufficient to pay the higher cost of the seed due to the greater expense of raising it and the frequency with which the seed crop will be injured by rains during the harvesting season. So far as our experiments have gone, they do not indicate that seeds grown in Michigan or in New York from carefully selected beets give any better results in these States than seed grown from equally well selected beets grown in Washington State. It was also found that Michigan-grown seed did not give any better results in Michigan than it did in any other States in which our experiments were conducted. On the contrary, the Washington-grown seed has so far proved the best everywhere.



